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Henry Ford Hospital, Detroit 2, Mich.

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Evaluation of Methods of Measuring the Accumulation of I^{131} by the Thyroid Gland[1]

JOHN P. STORAASLI, M.D., WILLIAM J. MacINTYRE, Ph.D., HYMER L. FRIEDELL, M.D., and KEITH E. WEIGLE, Jr., M.D.

A LITTLE OVER fifteen years has passed since it was shown by Hertz *et al.* (8) and Hamilton (7) that radioactive iodine could be put to good use in studying thyroid physiology. Most of the earlier thyroid function studies consisted in indirect measurements of the amount of a tracer dose of radioactive iodine excreted in the urine over a twenty-four to seventy-two-hour period (10, 23, 24, 25, 28). These tests were based on the premise that the thyroid gland was the only tissue which utilized iodine to any extent, and that amounts which were not metabolized were rapidly excreted in the urine. Keating and his group (11) extended these studies to show that more diagnostic information could be obtained if serial samples of urine were collected during the early hours of the test and assayed for radioactivity. If these samples were plotted against time, the renal excretion rate could be calculated, and from this the extrarenal (or thyroidal) rate of accumulation could be determined. While fairly accurate results were obtained by these methods, they appeared to offer several disadvantages. The principal handicap was the necessity of assuming that normal renal function existed and that no abnormal pooling of the iodide ion was present. (Secondary was the necessity of relying on the patient to collect total samples of urine.)

With the development of improved counting methods, radioactive iodine studies of thyroid function could be made by direct measurements over the thyroid gland, following relatively small tracer doses of the isotope. As a consequence, there have appeared in the literature a variety of diagnostic tests dealing with the physiological facets of the iodine cycle (2, 3, 4, 9, 12–15, 27, 29). The use of one or more of these tests has proved clinically useful in separating euthyroidism and hyperthyroidism.

Extensive reviews and analyses of the physiological aspects of thyroid function as it pertains to iodine metabolism have been reported by Riggs (21) and Oddie (17, 18). While it is not the purpose of this paper to discuss the fundamental aspects of the iodine cycle, it would appear that, in essence, the ideal objective of all studies of I^{131} uptake by the thyroid gland is information as to the metabolic turnover rate of thyroxine. Unfortunately, this is not a directly measurable quantity and clinically it is beyond the limits of practicability, since it would involve simultaneous

[1] From the Department of Radiology, School of Medicine, Western Reserve University, Cleveland, Ohio. This work performed primarily under A. E. C. Contract No. W31-109-eng-78, with Western Reserve University, Cleveland, Ohio. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

thyroid arterial and venous sampling, together with quantitative estimates of iodine and protein-bound iodine within the gland itself. For that reason, other approaches have been made to this fundamental assay. When there is an increased rate of formation of thyroxine (as in hyperthyroidism) the gland will necessarily be more avid for one of the fundamental constituents of the hormone, such as iodine. The rate at which iodine is converted into thyroxine has therefore been used in determining the rate of thyroxine formation. The methods by which this has been done are simply outlined as follows:

1. The total uptake of iodine in a specified period (usually twenty-four hours).
2. The rate of iodine uptake in a specified period.
3. The rate at which iodine is cleared from the plasma by the thyroid.

An even closer approximation of the avidity of the thyroid for iodine would be the rate at which the thyroid clears plasma at a specified flow of the latter to the gland. In other words, in addition to the clearance rate, the rate of blood flow to the thyroid should be known.

The first and easiest of these procedures, measurement of the total accumulation of radioactive iodine by the thyroid gland, is basic to thyroid function studies and determines the amount of available iodine for conversion into protein-bound iodine. It should be borne in mind, however, that the maximum accumulation is seldom if ever measured, since some loss in protein-bound iodine occurs before total collection is obtained, especially if the interval between administration of dose and measurement is long (twenty-four hours or more). The extent of this loss is dependent on the metabolic activity of the thyroid and thus is usually most significant in patients with hyperthyroidism.

In logical sequence, the second procedure would be a measurement of the rate at which the thyroid accumulates iodine, as suggested by Keating *et al.* (9) and Myant and Pochin (15), where not only the total accumulation of I^{131} is obtained, but also information concerning the rapidity with which such accumulation occurs.

Since the uptake of iodine by the thyroid is dependent upon the concentration of inorganic iodide available within the circulating plasma, the most specific approximation of thyroid function would be a measurement of the plasma clearance rate of I^{131}, as reported by Myant and Pochin (14, 16, 20), and with modifications by Berson and his associates (2). This would involve the determination of the accumulation rate of iodine within the thyroid gland as well as a third parameter, the plasma I^{131} concentration at a specified moment during the inscription of the accumulation curve. Since the rate of uptake of I^{131} by the thyroid is an exponential function dependent upon the concentration of I^{131} within the plasma, it would seem advantageous to make the measurements during the early hours following the administration of a tracer dose. Here greater increases in thyroid uptake at shorter intervals of time are anticipated, and one would therefore be working with those portions of the accumulation curve where the greatest change is to be expected.

In our laboratory, the 24-hour I^{131} uptake as measured directly over the thyroid gland has been found reliable in approximately 85 to 90 per cent of cases in distinguishing between euthyroidism and hyperthyroidism. In the remaining cases, borderline uptakes ranging from 40 to 50 per cent were obtained, and these were usually accompanied by borderline symptoms of hyperthyroidism. It was because of this that more elaborate and specific technics were deemed necessary for studying thyroid function.

With this in mind, studies were undertaken to evaluate the significance of the thyroid clearance rate of I^{131} and the simpler thyroid uptake of I^{131} as diagnostic procedures. To do this, a comparison was made of the 2-hour and 24-hour uptakes and clearance rates in a group of euthyroid and hyperthyroid patients. A group of

patients whose 24-hour uptakes were between 40 and 50 per cent were similarly studied to see whether the additional information would aid in determining their clinical status.

MATERIAL AND METHOD

The subjects studied were both inpatients and ambulatory patients. Prior to the test, all had a detailed clinical evaluation and were classified as either euthyroid or hyperthyroid. Close scrutiny of each individual was made concerning drug intake that might influence the avidity of the thyroid gland for iodine. If there was any doubt on this score, the patient was excluded from the study. Many had other illnesses in addition to the thyroid condition. These were not discarded, since the value of the I^{131} tracer study is not in substantiating an obvious diagnosis of hyperthyroidism but in the differential diagnosis of suspected cases. No separation of patients as to the presence or absence of goiter was made. Many had had previous subtotal thyroidectomies either for hyperthyroidism or non-toxic enlargement.

A selected group of patients with 24-hour I^{131} uptakes between 40 and 50 per cent were also studied. Each of these cases was classified clinically by an independent observer, in many of the patients a chemical protein-bound iodine determination was carried out by the method of Barker *et al.* (1). In our laboratory the normal range of protein-bound iodine is between 3.5 and 7.5 micrograms per cent, with an average of 5.8 ± 0.96. In this group of patients, the results of the thyroid clearance rate study were compared to the clinical evaluation as well as to the protein-bound iodine determinations.

The I^{131} tracer studies were carried out in a fasting state, the patient having no food for at least six hours prior to the test. Twenty-five to fifty microcuries of I^{131} as potassium iodide was given intravenously. A similar dose was diluted to approximately 45 c.c. in a 50-c.c. volumetric flask and used as a standard for purposes of comparison. The per cent uptake was determined over the thyroid gland at half-hour intervals for 3 hours and at 24 hours. All patient background determinations were obtained by counting over the thigh just above the knee. All measurements were made with a scintillation counter. Earlier in this study, an anthracene crystal was used, but later this was replaced by a thallium-activated sodium iodide crystal. Over this crystal a lead filter of 1/16 inch thickness was placed to reduce the effect of Compton scattered gamma radiation. The measuring distance of crystal to neck was normally 6 inches, occasionally increased to 9 inches for large glands. With the geometric arrangement of the crystal and lead collimation employed, the efficiency was such that 1 microcurie of radioactive iodine diluted to 45 c.c. in a 50-c.c. volumetric flask recorded approximately 2,000 counts per minute.

Heparinized blood samples were obtained at one hour and occasionally at two hours. These were centrifuged and the plasma decanted, assayed for radioactivity, and compared with the patient's standard. From these measurements, the percentage of administered dose of I^{131} per liter of plasma was calculated.

QUANTITATIVE MATHEMATICAL CONCEPTS

In the analysis of the thyroid clearance rate, the assumption is made that the amount of iodine removed both by the thyroid gland and the kidneys per unit time is proportional to the concentration of iodine present in the plasma pool. This is stated:

$$\frac{\Delta Qt}{\Delta t} \propto q_p \text{ or } \frac{dQt}{dt} = mq_p \qquad (1)$$

$$\frac{\Delta Q_k}{\Delta t} \propto q_p \frac{dQt}{dt} = nq_p \qquad (2)$$

where

Q_t = amount of I^{131} accumulated by the thyroid
Q_k = amount of I^{131} excreted by the kidney
m = volume of plasma cleared of I^{131} by the thyroid per unit time

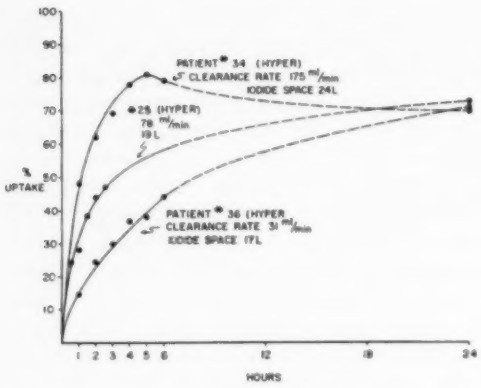

Fig. 1. Typical accumulation curves of I^{131} uptake by the thyroid gland. The greatest increase is seen to occur in the early period following administration of dose.

n = volume of plasma cleared of I^{131} by the kidney per unit time
q_p = concentration of I^{131} in the plasma

Now if V is equal to the volume of iodide space, the total I^{131} in the pool at any time must be $Vq_p = D - (Q_t + Q_k)$, where D is equal to the dose administered. On the assumption that during the time considered the release of the accumulated I^{131} by the thyroid is negligible, these equations may be integrated and solved simultaneously to give the equations:

$$Q_t = \frac{mD}{m+n}\left(1 - \exp\left[-\frac{m+n}{V}t\right]\right) \tag{3}$$

$$Q_k = \frac{nD}{m+n}\left(1 - \exp\left[-\frac{m+n}{V}t\right]\right) \tag{4}$$

It is seen that the parameter of primary interest is m, the volume of plasma cleared of I^{131} by the thyroid per unit time. This analysis follows the model of Myant, Pochin *et al.* (15, 16, 20) and has been worked out in detail by them.

The two quantities required for the measurement of the clearance rate are the rate of accumulation of I^{131} in the thyroid gland and the concentration of I^{131} in the plasma. Since the former is dependent on time, it was initially considered necessary to record a large segment of the early uptake (first six hours) in order to determine the optimum time for the rate determination. On inspection of typical curves as seen in Figure 1, and by differentiating Equation 3, it is seen that the greatest increase of uptake occurs when the time is very short. Since the relative experimental error is minimized when large changes are measured, it would thus seem advantageous to measure the slope at an early period.

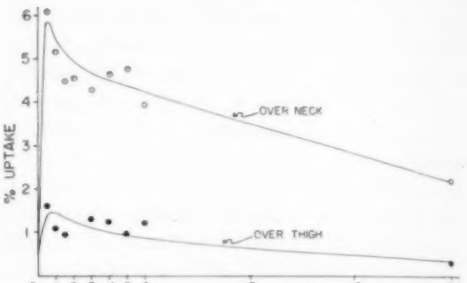

Fig. 2. I^{131} uptake measurement on the neck and thigh of a hypothyroid patient.

The disadvantage of a very early measurement is the complicating effect of background count caused by the extrathyroidal I^{131} in the neck. This will cause an increase in the early part of the curve resulting in a deviation from the expected exponential rise. The larger the amount of extrathyroidal tissue that the detector "sees" in proportion to the thyroid, the greater will this deviation be. Figure 2 shows the uptake measurement over the neck of a hypothyroid patient along with similar measurements made over the thigh. Since the final uptake is seen to be low (2.2 per cent), the early uptake must be almost entirely due to I^{131} present in the extrathyroidal tissue or circulating blood of the thyroidal region. The uptake measured over the thigh shows a similar rise and decline, but with a lower absolute value.

The method used in our laboratory has been to utilize a portion of the curve in which the variation in neck tissue uptake is small in relation to the variation in thyroid accumulation of I^{131}. This does

not necessarily require that the tracer concentration in the thyroid be substantially greater than that of the surrounding tissue, but that the amount of I^{131} in the extrathyroidal tissue be fairly constant during the period of radioiodine accumulation by the thyroid. For this reason, measurements at the end of one hour and two hours were considered more suitable for rate determination studies.

In order to obtain the thyroid accumulation rate, three methods were used and compared. The first involved plotting the I^{131} uptake curve and drawing the tangents at the desired time, t. In this way, the slope dQt/dt, or rate of uptake, may be found directly.

The second method was merely to take the readings one-half hour before and one-half hour after the hour and assume a linear increase over the one-hour interval. While this is, of course, only an approximation, it would provide the most rapid evaluation for clinical purposes if the agreement were sufficiently close.

The third method used to determine the slope was by differentiating Equation 3 to obtain the equation:

$$\frac{dQt}{dt} = \frac{mD}{m+n}\left(\frac{m+n}{V}\right)\left(\exp\left[-\frac{m+n}{V}t\right]\right)$$

and since the final uptake

$$Q_{fi} = m/(m+n)$$

$$\frac{dQt}{dt} = Q_{fi}\left(\frac{m+n}{V}\right)\left(\exp\left[-\frac{m+n}{V}t\right]\right) \quad (5)$$

This can be solved by measuring the maximum thyroid uptake Q_{fi} and determining the quantity $(m+n)/V$. Since:

$$Q_t = Q_{fi}\left(1 - \exp\left[-\frac{m+n}{V}t\right]\right)$$

$$\frac{Q_{fi}}{Q_{fi} - Q_t} = \exp\left[\frac{m+n}{V}t\right]$$

$$\ln\left(\frac{Q_{fi}}{Q_{fi} - Q_t}\right) = \left(\frac{m+n}{V}t\right)$$

By plotting the logarithm of $[Q_{fi}/(Q_{fi} - Q_t)]$ against t, a straight line of slope $[(m+n)/V]$ is obtained. This latter method of determining dQt/dt is perhaps theoretically more accurate, since the entire curve is used, whereas by both other methods a single inaccurate reading of Q_t would cause an error in the calculation of the slope at that point.

RESULTS

Table I gives the results obtained in 36 patients where the calculation of the thyroid accumulation rate and clearance rate were obtained by the three methods as outlined previously. The data indicate that the slope representing the per cent uptakes one hour apart is a reasonable approximation of the values obtained by using the entire curve. This is extremely important clinically, as it shows that the observations made in the first two hours of the reading give the same information as that obtained by recording the first six hours and the final uptake twenty-four to forty-eight hours later. The two-hour figure may, in fact, be even superior, since the maximum reading, Q_{fi}, is difficult to determine accurately in cases where I^{131} is being metabolized and is returned to the blood as thyroxine. In these cases, the value of Q_{fi} is merely an estimate of the value the curve would rise to provided the I^{131} were all stored and not released. In addition, in the determination of the exponent $[(m+n)/V]$, it is found that the semi-log plot is not a true linear relationship. Undoubtedly, one factor in this is that the uptake during the early reading is partially due to the activity in the extrathyroidal tissue of the thyroid region. When a small amount is estimated and subtracted from these readings, the linear relationship is more clearly approximated.

Also shown in Table I is a comparison of the thyroid clearance rates calculated by the three methods. These rates are tabulated with respect to time after injection of dose in order to determine which time would be best to use as reference. In patients with normal uptakes, little variation is seen between the first- and second-hour determination. In some cases of hyperthyroidism, however, the clearance rate may decrease after the first hour, and especially after three hours (not

TABLE I: COMPARISON OF THYROID CLEARANCE RATES BY THREE DIFFERENT METHODS

	Q_{fl}	Q_t	$\frac{m+n}{V}$	Slopes (%/hr.)*						Clearance Rates (ml./min.)					
				A		B		C		A		B		C	
				1 hr.	2 hr.	1 hr.	2 hr.	1 hr.	2 hr.	1 hr.	2 hr.	1 hr.	2 hr.	1 hr.	2 hr.
1	15	15	0.14	1.8	1.6	2.0	1.4	1.9	1.4	6.8	7.2	7.5	6.3	7.2	6.3
2	23	23†	0.12	2.3	2.1	2.2	1.6	2.4	1.6	11	...	11	...	11	...
3	26	25	0.17	3.8	3.2	4.0	2.4	4.2	2.7	9.6	9.7	10	7.5	11	8.4
4	27	26	0.17	3.8	3.2	3.4	2.5	3.7	2.5	13	13	12	10	13	10
5	28	28	0.12	3.0	2.6	2.7	2.2	3.0	2.0	9.6	9.9	8.7	8.4	9.6	8.9
6	29	29	0.20	4.7	3.9	3.6	2.7	4.4	2.8	...	18	...	13	...	13
7	30	30	0.15	3.9	3.3	4.1	3.2	4.0	3.2	17	22	18	21	18	21
8	30	29†	0.20	4.9	4.0	5.0	2.9	5.6	3.0	24	25	25	18	28	18
9	31	31	0.24	5.9	4.6	5.6	4.2	6.1	4.7		23		20		23
10	35	31	0.16	4.7	4.0	4.1	3.0	4.3	3.0	11	14	10	10	10	10
11	35	34	0.20	5.8	4.8	5.8	3.7	6.0	4.0	24	27	24	21	25	23
12	35	30	0.18	5.3	4.4	5.4	3.3	5.4	3.4	20	20	21	15	21	15
13	36	36	0.21	6.1	4.9	6.3	4.1	6.5	4.9	22	27	23	23	24	27
14	36	36	0.26	7.3	5.6	6.7	4.2	7.5	4.8	...	21		16		18
15	38	38	0.23	6.6	5.3	6.0	3.3	6.0	3.5	25	30	23	19	23	20
16	44	44	0.18	6.6	5.4	7.0	4.2	7.2	4.4	...	21	...	17	18	21
17	44	43	0.31	10.1	7.3	9.5	5.6	10.0	6.0	41	42	39	33	41	35
18	48	47†	0.26	9.5	7.3	8.3	5.5	8.5	5.5	27	22	24	17	24	17
19	50	48	0.18	7.3	6.1	6.9	5.7	7.1	6.0	...	19	...	17	18	17
20	58	58	0.27	12	9.2	12	6.5	13	6.5	58	54	58	38	62	38
21	61	61	0.33	15	10	13	8.8	14	9.0	61	69	54	59	58	60
22	62	61	0.30	14	10	14	7.7	14	8.0	58	55	58	41	58	43
23	62	60	0.36	15	11	12	8.2	13	9.4	81	85	64	65	69	75
24	66	64	0.41	18	12	19	8.2	18	9.0	83	80	91	56	83	62
25	67	60	1.11	25	8.1	25	12	26	12	...	110	...	160	...	160
26	71	71	0.19	11	9.2	11	6.8	11	7.5	31	38	31	28	31	31
27	75	59	2.2	18	2.0	10	2.4	25	2.5	390	75	200	89	530	89
28	77	77	1.77	28	12	27	11	28		310	150	300	138	310	137
29	79	79	0.49	24	15	18	9.0	21	10	110	110	86	69	98	77
30	82	81	0.51	25	15	21	11	25	11	208	156	175	115	213	115
31	81	70	0.74	29	14	23	12	25	12	216	173	175	150	190	152
32	83	72	1.40	34	10.1	59	4.1	43	5.0	460	290	790	120	580	140
33	86	85	1.12	36	12	22	6.1	22	6.0	320	350	192	181	192	179
34	87	83	0.71	30	15	24	10	25	11	...	164	...	113	...	120
35	89	70	1.00	33	12	23	9.4	25	10	304	149	217	117	233	124
36	90	89	1.15	33	10	43	5.2	36	5.2	201	...	260	...	220	...

* A. Slopes calculated by determinations of Q_{fl} and $(m + n)/V$. B. Slopes obtained by construction of tangents. C. Slopes obtained by construction of straight lines between readings one hour apart.
† Forty-eight-hour reading.

shown). This is undoubtedly due to the rapid turnover rate of inorganic iodine to protein-bound iodine which enters the blood stream.

The data indicate the advantages of making the measurements at the end of the first or second hour after the injection of the tracer dose, preferably after the first hour. At this time the activity of I^{131} in the plasma is the highest and thus most easily measured, and there is less chance of protein-bound radioiodine being present. As previously mentioned, the rate is also increasing most rapidly at the beginning of the curve. As the time, t, increases, the term $e - [(m + n)/V]\ t$ becomes smaller, indicating a reduced uptake rate. This expression shows also the advantage of measuring the rate at the first hour rather than the second hour, since for values of $[(m + n)/V]$ between 0.30 and 0.80 the expression $[(m + n)/V]\ e - [(m + n)/V]\ t$ varies only between 0.162 and 0.184 at the second hour, while for the same range, the variation is from 0.223 to 0.360 in the first hour.

From the foregoing results, the clearance rate appears to be best measured by recording the concentration of I^{131} in the plasma at the first hour after injection and determining the uptake rate of the thyroid at this point. This method, which appears most favorable from a patient's standpoint, was therefore adopted for the clinical studies. In view of the agreement among the various methods of calculating the slope, the clearance rates were calculated from the graphical construction of

TABLE II: RESULTS IN NORMAL PATIENTS

Patient	24-hr. Uptake (%)	2-hr. Uptake (%)	Thyroid Clearance Rate (ml./min.)
Intravenous administration			
1	33	14	21
2	41	19	16
3	20	8	11
4	25	11	11
5	20.5	8	6
6	20	7	6
7	46	23	30.5
8	28	11	16
9	23	9	16
10	16.5	5	9
11	39	9.5	12
12	38.5	19	28
13	43	18	36
14	37	15	19
15	30	10	16
16	17	6	6
17	31	12	14
18	23	7	12
19	42	11	17
20	23	7	10.5
21	19	4	11
22	22	5	5
23	35	8	15
24	21	6	8
25	50.5	36	26
26	48.5	13.5	18.5
27	27	7	5
28	22	8	6
29	22	7	6
30	41.5	20	26
31	36	15	17
32	21	7	3
33	31	10.5	11
34	44		25
35	47.5	22	19
36	29	10	18
37	28	7	12
38	22.5	6	11
39	25	5	4
40	26	8.5	13
41	29	11	20
42	37	17	10
43	25	9	14
44	25	5	5
45	23	7	12
46	41	13	17
47	20	7	11
48	28	7.5	8
49	30	10	10
50	23	4.5	6
51	23	5	10
52	35	10	11
53	34.5	12	24.5
54	21	7	9
55	27	4.5	5

TABLE II—*cont.*

Patient	24-hr. Uptake (%)	2-hr. Uptake (%)	Thyroid Clearance Rate (ml./min.)
Oral administration			
56	22	6	8
57	26	9	11.5
58	17.5	4.5	5
59	37	14	20
60	18	2	5
61	17	3	5
62	28	5	6
63	21	6	6
64	39	13	25
65	40	19	37
66	37	7	8
67	38	19	
68	27	5	11
69	60.5	12.5	11
70	15.5	5	5
71	31.5	7	14.5

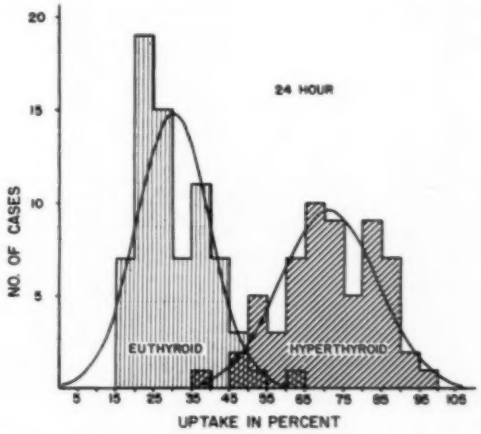

Fig. 3. Frequency distribution of 24-hour I^{131} uptake. The euthyroid group is shown to the left and the hyperthyroid group is shown on the right.

tangent, since little reason was shown for continuing the unwieldy mathematical derivation.

In Tables II and III are presented the thyroid clearance rates and the 2-hour and 24-hour uptakes of I^{131} in a group of 71 euthyroid and 61 hyperthyroid patients respectively. Table IV summarizes the data in Table II and III, giving the averages and ranges of each parameter measured. Also included in the tables are the results obtained following the oral administration of the tracer dose. It is quite evident that, so far as determination of the 24-hour uptake, 2-hour uptake, and clearance rate are concerned, whether in euthyroid or hyperthyroid individuals, it makes little difference whether the radioactive iodine is given intravenously or orally so long as the study is done in a fasting state. This is thought to be of interest, since it obviates the technical handicap of having

TABLE III: RESULTS IN HYPERTHYROID PATIENTS

Patient	24-hr. Uptake (%)	2-hr. Uptake (%)	Thyroid Clearance Rate (ml./min.)
Intravenous administration			
1	84	73	167
2	90	69	193
3	82	69	243
4	59	34	98
5	83	37	67.5
6	54	29	42.5
7	72	47.5	187
8	54.5	33.5	51
9	48	24	42
10	62	75	252
11	67	51	153
12	89.5	54	117
13	69	41	72
14	88	74	132
15	65.5	25	40
16	88	63	197
17	88	90	253
18	77	93	507
19	86	84	410
20	96	32	69
21	83	68.5	207
22	80	53	111
23	69.5	56	220
24	69	68	292
25	73	44	77.5
26	51.5	65.5	47
27	77.5	56	74
28	80.5	55	208
29	77	57.5	310
30	89	81	260
31	61	28	57
32	85	67	192
33	37	16	21
34	70	62	175
35	78.5	50	110
36	71	27	31
37	70	81	214
38	60	33	81
39	61	41	66
40	60.5	30	46
41	73.5	70	122
42	67	44.5	61.5
43	53	26	35
44	63.5	34	50
45	69	40	53
46	67	41	85
47	82	73	251
Oral administration			
48	65.5	31	59
49	58.5	24	51
50	79	72.5	177
51	73.5	74	227
52	89	71	287
53	72	38	64.5
54	65	74	461
55	83	51	100
56	55.5	54	77
57	66.5	60	94
58	51.5	58.5	256
59	64.5	32	90
60	49	5	6
61	83	47	77

to administer the tracer dose intravenously.

Figure 3 shows the frequency distribution of the 24-hour uptakes in both euthyroid and hyperthyroid patients. It will be seen that no distinct separation exists. If, in hyperthyroidism, a 24-hour uptake of 50 per cent is considered the probable lower limit of abnormality, it will be seen that in 3 cases of this group, the 24-hour uptake fell below that level. In the euthyroid group, 2 patients had uptakes greater than 50 per cent.

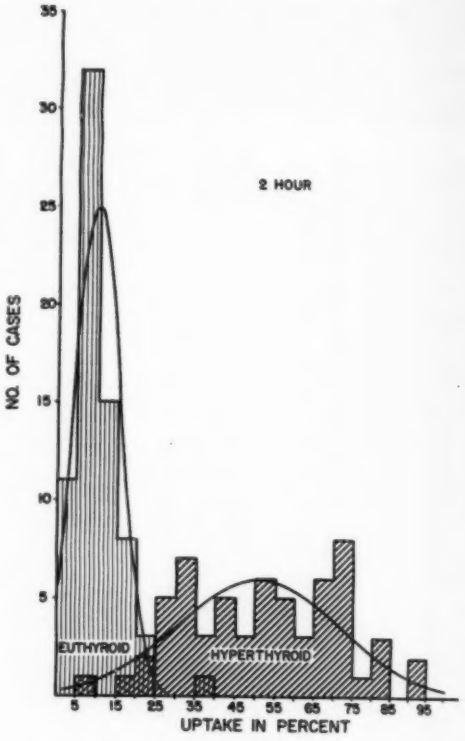

Fig. 4. Frequency distribution of 2-hour I^{131} uptake. The euthyroid group is shown to the left and the hyperthyroid group is shown on the right.

Figure 4 gives the frequency distribution of the 2-hour uptakes over the thyroid gland in both groups of patients. It was expected that measurements made during the early accumulation phase might have some advantage over a 24-hour measurement, diagnostically as well as from the standpoint of convenience, since the thyroid accumulation rate is an exponential function dependent upon plasma I^{131} concentration. In the hyperthyroid

group, if one excludes the 3 patients whose 24-hour uptakes were below 50 per cent, one would find only a single case with a 2-hour uptake of less than 25 per cent. Of the euthyroid patients, only 1 had a 2-hour uptake greater than 25 per cent, and this patient was 1 of the 2 having 24-hour uptakes in excess of 50 per cent. This test has the decided disadvantage, however, of being reliable only if the measurement is made at the designated time, for any premature or delayed measurement should theoretically be accompanied by a significant variation in uptake. Then, too, the errors that can accompany a single measurement must be taken into consideration. These would be difficult to correct by re-measurement since the determination is carried out during a dynamic phase of the process.

Figure 5 gives the frequency distribution of the thyroid clearance rate determined at one hour after the injection of radioactive iodine. In this case the logarithm of the clearance rate is plotted against the number of cases to obtain a gaussian distribution. In the hyperthyroid group, if one excludes from the plot of the clearance rates the 3 patients with 24-hour uptakes below 50 per cent, it can be seen that in only 1 instance is the thyroid clearance rate below 35 c.c. per minute, and in only 2 instances below 40 c.c. per minute. On the other hand, in the euthyroid group, no clearance rate greater than 36 c.c. per minute was obtained, and in only 2 instances was the clearance rate over 35 c.c. per minute. It is of interest to note that in the 2 patients with 24-hour uptakes in excess of 50 per cent, the thyroid clearance rates were held within the expected normal range.

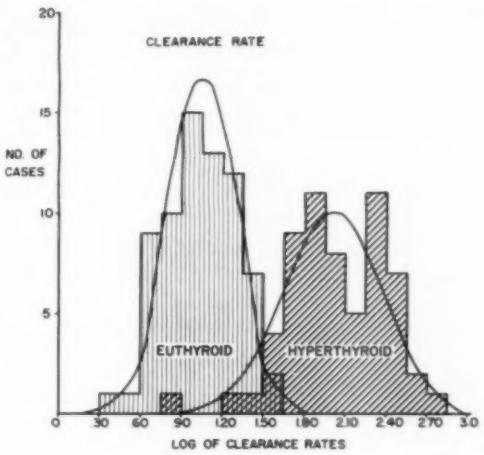

Fig. 5. Frequency distribution of clearance rates. The euthyroid group is shown to the left and the hyperthyroid group on the right. In order to obtain a gaussian distribution, the logarithm of the clearance rate is plotted against the number of cases.

TABLE IV: SUMMARY OF RESULTS

Group	Number in group	24-hr. Uptake (%)		2-hr. Uptake (%)		Thyroid Clearance Rate (ml./min.)	
		Average (%)	Range (%)	Average (%)	Range (%)	Average (c.c./min.)	Range (c.c./min.)
Euthyroid (I^{131} given I.V.)	55	30 ± 9	16.5–50	10.5 ± 6	4–36	13	3–36
Euthyroid (I^{131} given orally)	16	30 ± 12	15.5–60	8.6 ± 5	2–19	12	5–37
TOTAL	71	30 ± 9.6	15.5–60	10 ± 6	2–36	13	3–37
Hyperthyroid (I^{131} given I.V.)	47	72 ± 13	37–96	52 ± 19	16–93	145	21–507
Hyperthyroid (I^{131} given orally)	14	68 ± 12	49–89	49 ± 22	5.4–74	144	6–461
TOTAL	61	71 ± 13	37–96	52 ± 20	5.4–93	144	6–507

The use of the previously determined thyroid clearance rate in the group of 23 individuals with borderline uptakes has shown the difficulty of complete separation of euthyroid and hyperthyroid patients clinically. These 23 patients were selected on the basis of routine 24-hour uptakes because the latter fell between 40 and 50 per cent. Each case was evaluated clinically by an independent observer and classified as shown in Table V. In 10 cases

TABLE V: COMPARISON OF THYROID CLEARANCE RATES AND CLINICAL EVALUATION IN 23 PATIENTS WITH 24-HR. UPTAKES BETWEEN 40 AND 50 PER CENT

Patient	Clinical Classification	Protein-bound Iodine	24-hr. Uptake (%)	Thyroid Clearance	Correlated (G, F, P)
1	Normal	...	38	28	Good
2	Normal	4.4	39	21	Good
3	Normal	...	42	13	Good
4	Normal	...	43	18	Good
5	Normal	5.7	43	27	Good
6	Normal	5.1	44	26	Good
7	Normal	7.8	45	30	Fair
8	Normal	5.8	46	30	Fair
9	Normal	4.7	50	31	Fair
10	Normal	...	38	8	Good
11	Hyperthyroid	10.7	37	54	Good
12	Hyperthyroid	4.6	40	14	Poor
13	Hyperthyroid	6.5	44	20	Poor
14	Hyperthyroid	13.2	45	33	Fair
15	Hyperthyroid	4.4	46	19	Poor
16	Hyperthyroid	...	49	11	Poor
17	Hyperthyroid	6.0	50	78	Good
18	Hyperthyroid	13.5	51	33	Fair
19	Hyperthyroid	...	53	25	Poor
20	Borderline	...	45	24	
21	Borderline	7.3	45	45	
22	Borderline	...	47	19	
23	Borderline	6.8	49	31	

classified as euthyroid, the clearance rate substantiated the diagnosis, if the previous index is assumed to be reliable. In 5 of these cases, chemically determined protein-bound iodine serum measurements were performed and were within normal limits, with 1 case at the upper limits of normal.

In 9 cases designated as hyperthyroid, the correlation was even more difficult. The clearance rate definitely substantiated the diagnosis in 2 cases, while in 5 it seemed to be well within normal limits. In the remaining 2, it might be considered borderline (33 c.c./min.), and in these 2 patients serum protein-bound iodine determinations were abnormally high. In 1 instance the protein-bound iodine determination was normal while the clearance rate was definitely abnormal.

In the 4 cases classified as borderline, 1 had a clearance rate in the hyperthyroid range, the remaining 3 being in the normal range. Two protein-bound iodine determinations were within normal limits.

DISCUSSION

As more experience has been obtained with radioactive-iodine studies of thyroid function, certain information has been derived as to the limitations that should be recognized with the various diagnostic tests reported in the literature. Many of the earlier radioiodine tests were performed with attention mainly directed toward establishing normal and abnormal ranges of iodine metabolism. For these studies, highly selected populations were often chosen. As a result, most clinics considered the normal 24-hour thyroid uptake, measured directly, to lie between 10 and 40 per cent, with uptakes in excess of 50 per cent in hyperthyroidism and less than 10 per cent in hypothyroidism. As is pointed out, however, there is a range of uptake between 40 and 50 per cent, where the simple 24-hour uptake is difficult to correlate with the clinical findings.

As an examination of the frequency distributions of the various tests for radioiodine shows, there is a continuous spectrum of values ranging from low euthyroid to extreme hyperthyroid levels. The center saddle region of the spectrum is then due to the overlap of the normal group whose measurements fall in the hyperthyroid range and the patients classified as hyperthyroid whose measurements are in the normal range. This overlap is due to three reasons. First, since the syn-

drome of thyrotoxicosis is due to excessive amounts of thyroxine and since the range of thyroid hormone is probably continuous, the line demarcating normal from abnormal must be an arbitrary one. Second, the rather wide range of thyroid function in euthyroid individuals would indicate that certain levels of thyroid function and thyroxine secretion that might elicit symptoms of hyperthyroidism in one person might not produce this effect in others. Third, the classification of groups by clinical comparison will include some error in itself, which will be dependent only on the stringency of the standards applied.

In the present series, the comparison was made between euthyroid patients and hyperthyroid patients with symptoms of all degrees of severity. Some of the latter group had received previous treatment or had complicating illnesses. The classifications were made regardless of the presence or absence of enlargement of thyroid gland. With the groups as selected, the 24-hour uptake measurement, as shown in Figure 3, indicates that this test has been sufficient to separate all but approximately 3.5 per cent of the total cases. Since the classification encountered in normal clinical practice will include a much larger number of cases in the intermediate range, this region of uncertainty is probably closer clinically to 10 to 15 per cent.

In the frequency distribution curve of the 2-hour uptake measurements (Fig. 4), two pertinent characteristics are noted. First, the normal patients appear so closely grouped that for the theoretical distribution curve it is estimated that only about 1.5 per cent of those with normal thyroid function will show a 2-hour measurement over 22 per cent. Secondly, it is seen that the curve for the hyperthyroid group is broad and flat, embracing a large range of values. An examination of the theoretical frequency distribution shows that almost 8 per cent of the hyperthyroid group exhibit a 2-hour uptake less than the crossover point at 22 per cent. Thus, while the prediction of hyperthyroidism for any patient showing a 2-hour uptake over 22 per cent is fairly reliable, the prediction of a euthyroid state for any patient with a 2-hour uptake less than 22 per cent is considerably more uncertain.

The frequency distribution curve for the clearance rates is comparable in general configuration to that for the 24-hour uptake. The theoretical overlap is seen to be slightly higher, with 5.3 per cent of the normals falling in the hyperthyroid range and 6.4 per cent of the hyperthyroids in the euthyroid range. Our inability to obtain complete separation between the two groups of patients is not in complete agreement with the results of others. Berson *et al.* (2) reported a mean thyroid clearance rate of 17.7 c.c. per minute in a group of euthyroid patients and a mean of 210.5 c.c. per minute in a hyperthyroid group. No patient with hyperthyroidism had a clearance rate less than 74.5 c.c and no euthyroid patient had a clearance rate greater than 41 c.c. Myant and Pochin (15, 20) have reported normal clearance rates up to 45 c.c. per minute, with a mean of approximately 20 c.c. per minute. In their thyrotoxic patients the clearance rates were all above 80 c.c. per minute. Goodwin *et al.* (6) reported thyroid clearance rates up to 46 c.c. in a group of normal patients, while in obviously hyperthyroid patients the rate exceeded 75 c.c. In an intermediate group who were not hyperthyroid but presented features of past or present thyroid disorder, the clearance rate reached a level of 69 c.c. per minute.

It appears that the main differences in the results obtained in our laboratory and those reported by others lie in the criteria for diagnosis and selection of patients. This is especially important in the hyperthyroid group, where considerable variation in the mean value can be obtained depending upon the severity of symptoms in patients placed in this category.

Of greater importance is the application of clearance rate determinations to specific physiological conditions in which the simpler 24-hour uptake measurement may be subject to error. In the hyper-

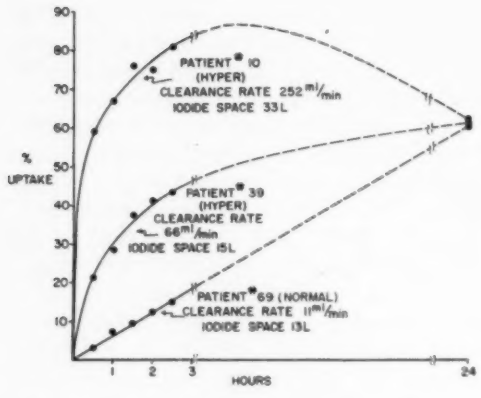

Fig. 6. Patients 10 and 39 illustrate two degrees of hyperthyroid avidity, with 10 showing a substantial loss of I^{131} at the 24-hour period. Patient 69 shows normal avidity but reaches a high final level because of renal insufficiency.

thyroid individual the 24-hour uptake is seldom a reflection of the maximum uptake, since by that time protein-bound iodine as thyroxine is already being secreted by the thyroid gland. Even the maximum uptake may not be an adequate reflection of the gland's avidity for iodine, since an appreciable release may be effected before the theoretical maximum value is ever attained. Similarly, in patients with impaired renal function, the single 24-hour uptake measurement may be deceptively high due to a lack of competition from the kidney in radioiodine removal. An illustration of these conditions is shown in Figure 6, which demonstrates the striking difference in avidity and clearance rate in 3 patients with the same range of 24-hour uptake.

In a physiological state of impaired circulation, such as cardiac decompensation in the presence of edema, the 24-hour uptake and especially the accumulation rate of iodine may be at deceptively low levels because of the increase in the iodide space due to pooling. Because the determination of the thyroid clearance rate is dependent upon the concentration of the iodide ion in the plasma, the effect of the above problem is eliminated. This is illustrated in Figure 7, which shows a normal clearance but an abnormally low 2-hour uptake and accumulation rate in a patient with a normal avidity but large iodide space (Curve A) and a similar uptake and clearance rate in a patient with a smaller iodide space (Curve B).

It is in this respect that the clearance rate has the most to offer. As is illustrated in Table V, while the 24-hour uptake

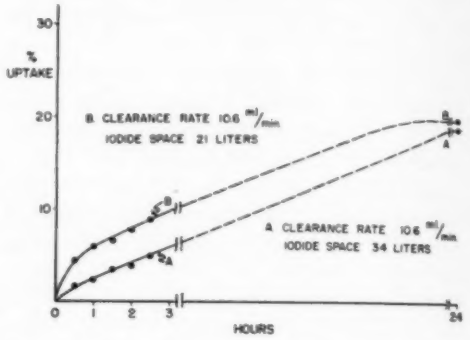

Fig. 7. Curve A shows the accumulation of I^{131} by the thyroid gland retarded by large iodide space as compared to a normal accumulation rate and normal iodide pool in Curve B.

measurement can do little to determine to which group patients in the borderline range belong, the clearance rate gave almost 100 per cent substantiation of the normal group while indicating that 4 of 9 patients clinically classed as hyperthyroid probably belonged in that category. The agreement of the clearance rate measurements with the protein-bound iodine determinations is also shown in this table.

As to a general comparison of measurements of thyroid accumulation of iodine with the protein-bound I^{131} determination, the latter as a reflection of the secretory phase of thyroid function appears to correlate very well with the clinical impression. Clark *et al.* (4), Freedberg *et al.* (5), and others (22, 26) have shown that the measurement of protein-bound I^{131} and the conversion ratio of I^{131} to protein-bound I^{131} in plasma are significantly elevated in hyperthyroid patients as compared to euthyroid individuals, if determined at a 24- or 48-hour period after the administration of a tracer dose.

Goodwin *et al.* (6), on comparing various diagnostic tests with I^{131}, feel that a single determination of the protein-bound I^{131} at a 48-hour period is the most specific test of thyroid function. It would appear that the limitations placed upon the iodine uptake studies and clearance rates would apply to this measurement as well. Both the determination of protein-bound I^{131} and radioiodine uptake studies fail to take into consideration the absolute rate of iodine turnover within the thyroid gland. These measurements depend upon the content of thyroxine within the thyroid, a quantity which is not measurable.

It would appear that, from the standpoint of obtaining the most information as to avidity of the thyroid gland for iodine, the clearance rate provides the most reliable index. Since it is a distinct advantage to be uninfluenced by the various physiological conditions, as discussed previously, the clearance rate is capable of making a somewhat sharper distinction between euthyroid and hyperthyroid cases in the important middle range.

Two factors, however, have kept this test from being adopted for routine use in this laboratory. The first is the additional time involved, which is somewhat restrictive in an active laboratory. The second is the fact that approximately 85 per cent of the patients studied can be classified as to their thyroid status by the simpler 24-hour uptake of I^{131} alone. In the remaining 15 per cent, other more elaborate tests will have to be carried out for better evaluation. The determination of the thyroid clearance rate, together with the determination of plasma concentration of protein-bound I^{131} or conversion ratios, will probably aid in 5 to 10 per cent of these cases. If one includes the chemically determined serum protein-bound iodine, further improvement in the clinical separation of patients would be anticipated. There will remain a few patients, however, in whom the clinical impression will have to be relied upon or in whom clinical treatment should be instituted for complete evaluation.

SUMMARY

1. In 132 patients classified clinically as euthyroid or hyperthyroid, a comparison was made of the thyroid clearance rate, and the 2- and 24-hour uptake of I^{131} by the gland.

2. A group of patients whose 24-hour uptakes were between 40 per cent and 50 per cent were similarly studied to see whether additional information obtained by clearance studies and protein-bound iodine determinations would aid in separating them as to their clinical status.

3. The various physiological circumstances complicating interpretation of I^{131} accumulation methods are discussed along with the factors that have led the authors to select specific tests to be applied routinely for more complete evaluation.

Western Reserve University
Cleveland, Ohio

REFERENCES

1. BARKER, S. B., HUMPHREY, M. J., AND SOLEY, M. H.: Clinical Determination of Protein Bound Iodine. J. Clin. Invest. **30**: 55–62, January 1951.
2. BERSON, S. A., YALOW, R. S., SORRENTINO, J., AND ROSWIT, B.: Determination of Thyroidal and Renal Plasma I^{131} Clearance Rates as a Routine Diagnostic Test of Thyroid Dysfunction. J. Clin. Invest. **31**: 141–158, February 1952.
3. BROWNELL, G. L.: Analysis of Techniques for the Determination of Thyroid Function with Radioiodine. J. Clin. Endocrinol. **11**: 1095–1105, October 1951.
4. CLARK, D. E., MOE, R. H., AND ADAMS, E. E.: Rate of Conversion of Administered Inorganic Radioactive Iodine into Protein-bound Iodine of Plasma as an Aid in the Evaluation of Thyroid Function. Surgery **26**: 331–340, September 1949.
5. FREEDBERG, A. S., URELES, A., AND HERTZ, S.: Serum Level of Protein Bound Radioactive Iodine (I^{131}) in the Diagnosis of Hyperthyroidism. Proc. Soc. Exper. Biol. & Med. **70**: 679–682, April 1949.
6. GOODWIN, J. F., MACGREGOR, A. G., MILLER, H., AND WAYNE, E. J.: Use of Radioactive Iodine in the Assessment of Thyroid Function. Quart. J. Med. **20**: 353–387, October 1951.
7. HAMILTON, J. G.: Rates of Absorption of the Radioactive Isotopes of Sodium, Potassium, Chlorine, Bromine, and Iodine in Normal Human Subjects. Am. J. Physiol. **124**: 667–678, December 1938.
8. HERTZ, S., ROBERTS, A., AND EVANS, R. D.: Radioactive Iodine as an Indicator in the Study of Thyroid Physiology. Proc. Soc. Exper. Biol. & Med. **38**: 510–513, May 1938.
9. KEATING, F. R., JR., HAINES, S. F., POWER, M. H., AND WILLIAMS, M. M. D.: Radioiodine-Accumulating Function of the Human Thyroid Gland as a Diagnostic Test in Clinical Medicine. J. Clin. Endocrinol. **10**: 1425–1464, November 1950.
10. KEATING, F. R., JR., POWER, M. H., BERKSON, J., AND HAINES, S. F.: Urinary Excretion of Radioiodine in Various Thyroid States. J. Clin. Invest. **26**: 1138–1151, November 1947.

11. KEATING, F. R., JR., AND OTHERS: Measurement of the Iodine-Accumulating Function of the Human Thyroid Gland. J. Clin. Invest. **28:** 217–227, March 1949.

12. KRISS, J. P.: Uptake of Radioactive Iodine After Intravenous Administration of Tracer Doses. J. Clin. Endocrinol. **11:** 289–297, March 1951.

13. MILLER, E. R., DAILEY, M. E., HOLMES, A. V., ALEXANDER, G. L., AND SHELINE, G. E.: Studies with Radioiodine. I. Function and Rate of I^{131} Uptake of Thyroid. Radiology **57:** 37–46, July 1951.

14. MYANT, N. B.: Radioiodine Tests of Thyroid Function in Man. Brit. M. Bull. **8:** 141–147, 1952.

15. MYANT, N. B., AND POCHIN, E. E.: Thyroid Clearance Rate of Plasma Iodine as a Measure of Thyroid Activity. Proc. Roy. Soc. Med. **42:** 959–961, December 1949.

16. MYANT, N. B., POCHIN, E. E., AND GOLDIE, E. A. G.: Plasma Iodide Clearance Rate of the Human Thyroid. Clin. Sc. **8:** 109–133, July 1949.

17. ODDIE, T. H.: Analysis of Radio-iodine Uptake and Excretion Curves. Brit. J. Radiol. **22:** 261–267, May 1949.

18. ODDIE, T. H., AND SCOTT, R. K.: Results of Uptake and Excretion Tests with Radio-iodine. Brit. J. Radiol. **23:** 348–354, June 1950.

19. PERRY, W. F., AND HUGHES, J. F. S.: Urinary Excretion and Thyroid Uptake of Iodine in Renal Disease. J. Clin. Invest. **31:** 457–463, May 1952.

20. POCHIN, E. E.: Investigation of Thyroid Function and Disease with Radioactive Iodine. Lancet **2:** 41–46, July 8, 1950; 84–91, July 15, 1950.

21. RIGGS, D. S.: Quantitative Aspects of Iodine Metabolism in Man. Pharmacol. Rev. **4:** 284–370, September 1952.

22. SCHULTZ, A. L., SANDHAUS, S., DEMOREST, H. L., AND ZIEVE, L.: Clinical Value of Plasma Butanol-Extractable (Thyroxine) I^{131} in Diagnosis of Hyperthyroidism and Myxedema. J. Clin. Endocrinol. & Metab. **14:** 1062–1068, September 1954.

23. SEED, L., JAFFE, B., AND BAUMEISTER, C.: Tracer Dose of Radioactive Iodine in the Diagnosis of Thyroid Disease. J. Clin. Endocrinol. **11:** 1143–1156, October 1951.

24. SHIPLEY, R. A., STORAASLI, J. P., FRIEDELL, H. L., AND POTTS, A. M.: I^{131} in the Diagnosis and Treatment of Hyperthyroidism. Am. J. Roentgenol. **64:** 576–589, October 1950.

25. SKANSE, B.: Radioactive Iodine in the Diagnosis of Thyroid Disease. Acta. med. scandinav. (Supp. 235) **136:** 1–186, 1949.

26. VAN MIDDLESWORTH, L., NURNBERGER, C. E., AND LIPSCOMB, A.: Simplified Sensitive Test for Thyroid Function, Using Protein-Bound I^{131}. J. Clin. Endocrinol. & Metab. **14:** 1056–1061, September 1954.

27. WERNER, S. C., HAMILTON, H. B., LEIFER, E., AND GOODWIN, L. D.: An Appraisal of the Radioiodine Tracer Technic as a Clinical Procedure in the Diagnosis of Thyroid Disorders. Uptake Measurement Directly Over the Gland and a Note on the Use of Thyrotropin (T.S.H.). J. Clin. Endocrinol. **10:** 1054–1076, September 1950.

28. WERNER, S. C., QUIMBY, E. H., AND SCHMIDT, C.: Clinical Experience in Diagnosis and Treatment of Thyroid Disorders with Radioactive Iodine (Eight-Day Half-Life). Radiology **51:** 564–578, October 1948.

29. WERNER, S. C., QUIMBY, E. H., AND SCHMIDT, C.: Use of Tracer Doses of Radioactive Iodine, I^{131}, in the Study of Normal and Disordered Thyroid Function in Man. J. Clin. Endocrinol. **9:** 342–354, April 1949.

SUMARIO

Justipreciación de los Métodos Empleados para Medir la Acumulación de I^{131} por el Tiroides

Estos estudios se emprendieron para valuar la importancia del tiempo que emplea el tiroides para desembarazarse del yodo radioactivo y de la determinación más sencilla de la absorción por el tiroides como procedimiento diagnóstico. Para ese fin, se hizo una comparación de las absorciones de 2 horas y de 24 horas y de los coeficientes de desembarazo en una serie de individuos eutiroideos e hipertiroideos. Un grupo de enfermos "limítrofes," cuyas absorciones de 24 horas quedaban entre 40 y 50 por ciento, fué estudiado en forma semejante para averiguar si la información complementaria aportada por los estudios del desembarazo y las determinaciones del yodo proteíno-fijo ayudarían a determinar la posición de los mismos.

Discútense las circunstancias fisiológicas que pueden complicar la interpretación de varios métodos de acumulación, deduciéndose que, por verse afectado por dichos factores, el coeficiente de desembarazo ofrece el índice más fidedigno de la avidez del tiroides hacia el yodo, siendo capaz de trazar una distinción más neta entre los casos eutiroideos e hipertiroideos de la zona limítrofe.

Sin embargo, dos factores han impedido la adopción de esta prueba como sistema en el laboratorio de los AA.: (1) Consume tiempo y (2) aproximadamente 85 por ciento de los casos pueden ser clasificados más sencillamente a base de la prueba de absorción de 24 horas.

Lesions with Chronic Symptoms Producing Pyloric Obstruction and Gastric Decompensation[1]

ARNOLD D. PIATT, M.D., and GERALD A. ERHARD, M.D
Newark, Ohio

OCCASIONALLY on roentgen examination of the upper gastrointestinal tract, one encounters a tremendous dilatation of the stomach with a pronounced retention of gastric fluids. An obstruction is found at the pyloric end of the stomach. With the history of chronic symptoms, the question arises as to the pathologic process producing this phenomenon. Can a preoperative diagnosis be made with a reasonable assurance of correctness?

It has been our feeling in the past that a diagnosis of primary benign peptic ulcer as the causative factor could most often be justifiably offered in the presence of chronic symptoms referable to the upper gastrointestinal tract and the roentgen demonstration of a persistent pyloric obstruction with gastric decompensation. In reviewing the subject in the literature, it was of considerable interest to note the conflicting opinions concerning this problem.

According to Köhler (25), enormous dilatation with an extreme delay in emptying of the stomach is probably dependent upon a fibrotic stenosis of the pylorus. He goes on to say that in malignant stenosis, in spite of the abnormal retention, extreme dilatation does not usually result. Yet one should consider the possibility that a previously dilated stomach may become carcinomatous, implying that malignant change may occur in a lesion originally benign or may exist in conjunction with a benign lesion. Stone and Ruggles (34) make the following observations on obstructive lesions, which, however, are not pathognomonic. "In ulcer cases the stomach is grossly dilated, atonic and lies obliquely across the abdomen with the pylorus to the right of the midline. In carcinoma, the stomach is not grossly dilated but is frequently contracted so that the pylorus lies to the left of the midline and it does not appear atonic." Feldman (18), on the other hand, asserts that there is no x-ray basis for the assumption that a dilated stomach is due to a benign obstruction and an obstructed non-dilated stomach to malignant disease. He lists numerous entities producing dilatation of the stomach, naming pyloric ulcer, carcinoma of the pylorus, pyloroduodenal ulcer or inflammations, duodenal ulcer, duodenal stenosis, adhesions, syphilis, hypertrophic pyloric stenosis, benign pylorospasm, and extrinsic pressure. Anderson (3) mentions other possibilities, as pedunculated benign or malignant tumors near the pyloric valve, foreign bodies, congenital duodenal atresia, and congenitally enlarged mucosal folds of the pylorus.

Presenting several cases with perigastric adhesions and bands involving the pyloric antrum, Jenkinson (23) cites two other reports (22, 35) of anomalous abdominal membranes or bands producing chronic symptoms with obstruction and marked gastric dilatation. Pillmore (32) states that ulcers occurring at the pyloroduodenal junction involve the pyloric sphincter and the duodenal cap and "these are most often benign. They usually originate in the duodenal cap close to the sphincter." Carman (14) made the observation that "a six-hour residue with a large stomach of normal contour showing hyperperistalsis means, more than ninety out of a hundred times, obstructive duodenal ulcer." Bell (6) remarks that spastic pyloric stenosis in adults is more frequent than organic disease and is usually due to an ulcer factor, although organic pyloric stenosis is most often attributed to ulcer with cicatrization. He mentions other conditions

[1] Accepted for publication in September 1954.

which might produce this same result, such as carcinoma, infected gallbladder with adhesions in the region of the pylorus and extension of the inflammation into the stomach or duodenum, and benign tumors.

To quote Golden (20): "Pyloric obstruction associated with duodenal ulcer is in the great majority due to pylorospasm, not to organic constriction of the sphincter. This is associated with edema of the mucosa. The spasm is very persistent, it is often associated with a large gastric residue, and may make it impossible to outline the bulb." Somewhat contrary to this statement was Barclay's opinion (5) that an organic lesion prevailed when powerful peristaltic waves were persistently ineffective in association with definite delay in emptying. He felt that intermittent and powerful peristalsis was almost characteristic of long standing obstruction and that reverse peristalsis was seen to be weak in comparison and never forceful. In discussing the prepyloric suspect lesion, Alexander (1) states: "In some cases, however, with a malignant prepyloric lesion, the duration of the gastric symptoms may extend over a period of years, suggesting the possibility of some associated disease as a contributing factor. . .when pyloric obstruction with marked weight loss is a prominent feature, the usual signs of extensive disease are present and the diagnosis is not difficult." Meyer (30) asserts that any attempted histologic interpretation by roentgen methods is but a surmise based upon gross appearance and statistical average. He also advocates the roentgen study of gastric dysfunction as a means of differential diagnosis, listing the indirect roentgen data which are of paramount importance.

The pathologists (3, 6, 8, 24) are in accord that cicatricial constriction is one of the most serious of the late effects of peptic ulcer at the pyloric ring, leading to pyloric stenosis with great dilatation of the stomach. Karsner (24) makes the comment that rarely does pyloric hypertrophy occur in adults and that it is probably secondary to a chronic gastritis. He also states that congenital pyloric hypertrophy leads to only moderate dilatation of the stomach.

Consideration of the normal anatomy and physiology of the stomach is not within the scope of this article, though a review of these subjects was necessary in order to comprehend and appreciate their abnormal aspects. References which were utilized are submitted for the purpose of further study if the reader so desires (4, 5, 7, 12, 13, 15, 16, 20, 21, 28, 29, 33, 36).

CLINICAL FEATURES

The clinical picture of pyloric obstruction with gastric decompensation is a familiar one, with symptoms present over a number of years. A history of long-standing gastric distress can be obtained from nearly every patient. Some report a diagnosis of peptic ulcer on previous examinations. Pain is a prominent feature, varying from soreness of dull character to acute, sharp, boring pain in the mid abdomen or in the upper epigastrium. Nausea, eructation, and vomiting are disturbing symptoms, increasing in frequency, duration, and severity. The episodes of vomiting, which at first occur intermittently after meals, become a major problem. The vomitus consists of undigested food and sour smelling gastric juices and fluids. A feeling of "hot water brash" is the description by some of the patients after one of these vomiting bouts. The symptom termed "heart burn" is frequently referred to and often is relieved by alkalies. Fullness or bloating in the upper and mid epigastrium is another complaint, alleviated by belching or vomiting. A loss in weight is noted by most patients. This may range from a few pounds to as much as forty pounds. Reference is frequently made to increasing constipation which does not seem to be relieved by laxatives. Nervousness and irritability are also mentioned.

The patients on the whole appear somewhat asthenic, showing signs of dehydra-

tion. On examination of the abdomen, one may find occasionally some upper abdominal distention with tenderness on palpation, often difficult to localize. Most frequently the tenderness is above the umbilicus and to the right of the mid-line. In some cases, one has the impression of a mass density in the epigastrium.

ROENTGEN ASPECTS

The roentgen findings in the reported cases were quite uniform and strikingly similar. Marked dilatation of the stomach was evident on fluoroscopy even before the ingestion of a contrast medium. With the patient in the upright position, a huge fluid level could be visualized in the pars cardia or media surmounted by a large gas bubble, indicating a pronounced hypersecretion and gastric retention. On the administration of barium, a "molasses-drip" effect was obtained, evidently due to the presence of excessive amounts of mucus retained in the stomach and its incomplete mixing with the barium preparation. Mottling and large filling defects were occasionally observed, produced by retained undigested food particles which frequently simulated a gastric bezoar. There was a tremendous ballooning of the stomach, at times with a violent propulsive peristaltic effort to force the gastric contents through the pyloric sphincter. Alternating periods of quiescence and hyperperistalsis were noted, with occasional weak reverse peristaltic waves. Antral distention was another striking feature. The rugae of the stomach were flattened and obliterated in most instances. The obstructive phenomenon at the pyloric end of the stomach was obvious, with a tendency to tapering at the pyloric tip. One could note a smoothness of the luminal margins in the distal portion of the stomach and on palpation and manipulation the stomach walls seemed less pliable in this region.

In some cases there seemed to be fixation at the pyloric ring or in the region of the duodenal bulb as evidenced by limited mobility and separability. The pylorus seemed displaced to the right. When contrast medium could be forced through the stenotic pyloric ring, it was only in a thin trickle, which allowed visualization of the pyloric sphincter canal and gave an impression of its elongation. The duodenal bulb could rarely be filled, and demonstration of an ulcer crater was infrequent. A copious gastric residue was noted at six hours and assumed a "half-moon" appearance, the residue hanging in the mid-line. Occasionally a small amount of barium had been eliminated from the stomach and was irregularly scattered in the small intestinal tract, as in a deficiency state. The twenty-four-hour examination still revealed the retention of a large quantity of contrast medium in the stomach.

PATHOLOGY

At surgery, necessitated by the persistent pyloric obstruction, the stomach was found to be quite large and distended, often edematous, even after prolonged continuous suction and lavage. In several cases where the lesions were benign, the pylorus seemed thickened, especially near the ring, with varying degrees of edema. Quite often a tumor-like thickening at the pyloric sphincter prevailed, simulating a neoplasm. Of 2 cases in the present series with malignant involvement, 1 revealed an infiltration of the pylorus from a contiguous extrahepatic neoplasm which pulled the pylorus upward and partially immobilized it; the other showed indurated nodules at the pyloric end of the stomach with an old healed ulcer on the anterior aspect of the surface of the pylorus and an annular constricting thickening in the pyloric region which seemed to be fibrous tissue. Also, in this latter case, an old perforated ulcer on the posterior surface of the duodenum was observed, extending into the pyloric ring. Some of the cases showed scarring or deformities of the duodenal bulb when the primary benign ulcer originated on the duodenal side and then later invaded the pyloroduodenal junction with cicatrix formation. Quite fre-

quently fixation to the adjacent structures existed as the result of inflammatory involvement, previous perforation, and adhesions. In the cases of apparently benign lesions for which gastric resections were undertaken, the muscular layer in the pyloric portion of the stomach seemed somewhat thickened and hypertrophied. The rugal folds in the distal half of the stomach, especially near the tip of the pylorus, appeared flattened or obliterated due to inflammation and edema. The mucous membrane had a smooth, glistening appearance and seemed thinned. Retained undigested food particles were often found, accounting for the "bezoar-like" defects noted in the radiographic studies. A stenosis of the pyloric sphincter canal was observed which sometimes reached the point of complete occlusion.

Microscopic observations on the gastric resection specimens were made by several pathologists. In the benign cases, the findings were somewhat similar, the picture being that of a chronic gastritis. The mucous membrane varied, ranging from average normal thickness to a definite thinning in some areas, especially near the pyloric end of the stomach. One case revealed evidence of mild mucosal digestion. The glandular elements were slightly dilated, with the secretory cells in various stages of activity. The epithelial cells of the mucosa seemed to maintain normal polarity and staining qualities. Throughout the stroma of the mucosa and the submucosa, an infiltration of lymphocytes, some eosinophils, and polymorphonuclear cells existed, with marked predominance of the first. The submucosa was thickened, with evidence of edema. The lymphatic channels showed some crowding, mainly with plasma cells and lymphocytes of the inflammatory type. The muscularis layer was increased in thickness due to inflammatory cells invading the interstitial connective tissue and some cell hypertrophy. McCann and Dean (28), however, feel that gastritis can accompany or follow stenosis but that it is unlikely that true hypertrophy would accompany or result from either an ulcer or gastritis. The nerve fibers and endings appeared within normal limits, although Boyd (8) states that a neuritis and perineuritis may occur at some distance from an ulcer, with the ganglion cells disappearing and the nerve fibers coiling into masses resembling amputation neuromas. According to Golden, edema and inflammatory reaction in the submucosa and the tunica muscularis apparently affect the nerve plexuses. One pathologist reported "no particular cuffing of the blood vessels," although some hyperemia and dilatation of the vessels would be expected.

Surprisingly, in none of the reported specimens was reference made microscopically to any fibrosis occurring in the submucosa, muscularis, or serosal layers in the region of the pylorus. The presence of an ulcer in the resected specimens was observed in only a few cases.

Contrary to an expected benign lesion, one patient had a malignant neoplastic infiltration of the stomach which was secondary to a primary extrabiliary adenocarcinoma. There were marked fibroblastic reaction and induration in the region of the primary tumor. Tumor cells of the same histologic pattern as in the primary lesion, arranged in alveoli, involved the entire gastric wall, even invading the gastric mucosa. Another patient had a coexisting benign peptic ulcer and an adenocarcinoma in the pyloric region of the stomach. The pathologist could not ascertain the location of the peptic ulcer due to deformity of the pylorus. The impression was that these were two distinct and separate entities. Two additional cases suggested neoplastic involvement, but this could not be confirmed and, in one of the cases, a biopsied node was negative for tumor.

Eighteen cases seen by the authors are presented in Table I, and 5 of these are reported in fuller detail.

CASE REPORTS

CASE I: W. S., white male, age 56, had symptoms for the past three years suggesting a peptic ulcer,

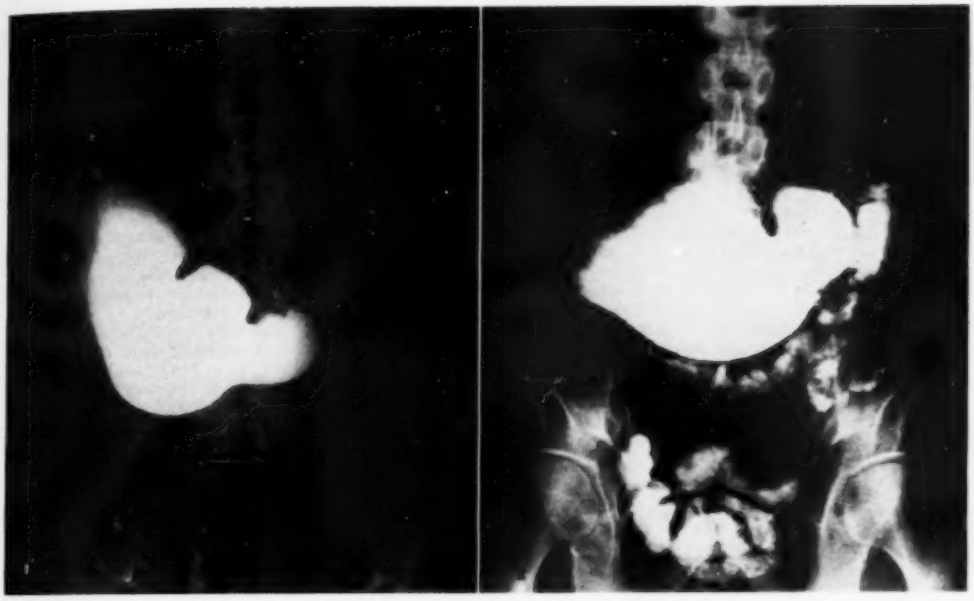

Fig. 1. Case I. Large dilated stomach showing fairly good tonus with active peristaltic waves. Note the "peaking" and stenosis at the pyloric tip. A fleck of barium is seen in the duodenal bulb. Only a small quantity of the contrast material has passed into the small intestine on the initial examination.

Fig. 2. Case I. The twenty-four-hour film study shows the pronounced gastric retention of contrast medium. The stomach appears more dilated than on the initial examination and a large gas bubble is seen in the pars cardia. It is evident that a marked fluid retention is present.

consisting of sour eructations and epigastric discomfort several hours after meals, relieved by food and soda. He had been placed on a Sippy régime, with medication consisting principally of antacid powders, belladonna, and phenobarbital. Some improvement occurred, but several weeks prior to admission in the hospital, the abdominal pain increased in severity and frequency, with episodes of nausea and vomiting. There was no evidence of blood in the vomitus at any time, nor were the stools tarry. Constipation necessitated laxatives. The patient appeared apprehensive and nervous.

Physical examination was essentially normal except for slight distention of the abdomen and palpable discomfort in the epigastrium which could not be localized. The skin was dry, showing evidence of dehydration.

The laboratory procedures were limited, with no blood chemistry studies. The hemoglobin was 97 per cent, red blood cells 5,200,000, white cells 10,150. Urinalysis was essentially normal.

X-ray examination just prior to the hospital admission was reported as follows: "the stomach . . . extremely large . . . showing diminished tone. A gastric hypersecretion was present with a 'molasses drip-like effect' noted. Peristalsis was sluggish; later quite active, with marked antral distention (Fig. 1). Six-hour study revealed a marked gastric residue, with only a slight quantity of barium in the small intestinal tract. Twenty-four-hour examination still showed a marked gastric retention with only a moderate amount of barium entering the small intestine (Fig. 2)." A presumptive diagnosis of peptic ulcer with obstruction was offered.

A gastric resection was performed three days after admission. Indurated nodules were found at the pyloric end of the stomach just proximal to the pyloric vein. There was an old healed ulcer scar on the anterior surface of the pylorus and an old perforated ulcer on the posterior surface of the duodenum, penetrating into the pylorus. One large firm node was found in the gastrohepatic ligament. The diagnosis after microscopic examination was benign peptic ulcer; adenocarcinoma of the pyloric region of the stomach.

The patient died nine days postoperatively from a respiratory complication.

Remarks: The existence of both a benign peptic ulcer and adenocarcinoma of the pylorus certainly presented a confusing picture, although it is our strong feeling that the peptic ulcer was the principal offender in the production of the obstruction and the subsequent gastric changes. The hemoconcentration due to the dehy-

TABLE I

Case No.	Age and Sex	Habitus	Laboratory Findings	Duration Symptoms	X-ray Findings
1	56M	Asthenic. Some weight loss	RBC: 5,200,000 Hb: 97%	3 years of abdominal pain	Obstuction at pyloric ring. Large stomach. 6- and 24-hour residue
2	70F	Sthenic. 20 lb. weight loss	RBC: 4,940,000 Hb: 15.5 gm. BUN: 18.5 mg.	5 years. Indigestion	Benign pyloric obstruction with peptic ulcer at pyloric ring. Marked 6-hour retention
3	42M	Hypersthenic	RBC: 5,120,000 Hb: 14.9 gm. BUN: 15.5 mg. Hematocrit: 54	20 years of stomach trouble	Benign postpyloric obstruction from old duodenal ulcer. Non-functioning gastroenterostomy stoma. 24-hour retention
4	26M	Asthenic. 30 lb. weight loss	RBC: 4,320,000 Hb: 75% T.P.: 6.4 gm. %	2 years	Pyloric obstruction from stenosing duodenal ulcer
5	63M	Sthenic. No weight loss	RBC: 4,240,000 Hb: 13.2 gm. BUN: 14.5 mg.	Several years	Dilated stomach. Pyloric obstruction. 6-hour retention
6	62F	Asthenic	RBC: 5,500,000 Hb: 13.5 gm. NPN: 56 mg.	2–3 years	Stenosing lesion at pyloric ring from benign peptic ulcer
7	59M	Asthenic	RBC: 4,900,000 Hb: 89%	12 years. Upper abdominal pain	Duodenal ulcer with obstruction. Large stomach with atony. 6-hour retention
8	69F	Asthenic. Malnutrition. 22 lb. weight loss	RBC: 4,700,000 Hb: 92%	Several years. Vomiting for past 6 months	Huge dilated stomach. Marked gastric retention at 6 hours
9	74M	Asthenic. Malnutrition. Considerable weight loss	RBC: 3,600,000 Hb: 56% BUN: 14 mg.	Many years. Gastrointestinal symptoms with occult hemorrhage	Gastric decompensation and pyloric obstruction
10	82M	Sthenic. Normal weight	RBC: 5,400,000 Hb: 95%	18 years. Duodenal ulcer	Pyloric obstruction, with hugely dilated stomach. Antral distention. 6-hour retention
11	59M	Sthenic	RBC: 4,840,000 Hb: 93% BUN: 60 mg.	Chronic duodenal ulcer for 30 years	Large dilated stomach with pyloric obstruction. Deformed bulb. Marked 6-hour retention
12	46M	Hypersthenic	RBC: 3,740,000 Hb: 71%	Ulcer 2 years earlier. Upper gastrointestinal distress	Dilated stomach. Scarred duodenal bulb. 40% retention at 6 hours
13	48M	Sthenic	RBC: 4,010,000 Hb: 85%	16 years. Repair of perforated ulcer 4 years earlier	Dilated stomach. Duodenal ulcer. 90% retention at 6 hours
14	80F	Asthenic. 15 lb. weight loss	RBC: 4,510,000 Hb: 83% NPN: 51	Many years of stomach trouble	Pyloric obstruction with dilated stomach. Probable duodenal ulcer
15	60M	Asthenic	RBC: 4,640,000 Hb: 88%	1 year	Gastric dilatation. Almost complete retention at 24 hours due to pyloric obstruction
16	76M	Asthenic. 50–60 lb. weight loss	RBC: 4,170,000 Hb: 81%	Several years of abdominal pain	Obstruction at pylorus
17	46M	Asthenic. 10 lb. weight loss	RBC: 4,310,000 Hb: 85%	Several years	Pyloric obstruction. Dilated stomach. Marked 6-hour retention
18	62F	Asthenic. Weight loss	RBC: 4,350,000 Hb: 84.3% T.P. 6.0 gm. %	Peptic ulcer 2 years earlier. Abdominal pain	Extreme dilatation of stomach. Pyloric obstruction. Marked 6-hour retention

TABLE I

Type Operation	Operative Findings	Pathological Report	Survival	Case No.
Gastric resection. Posterior Polya	Indurated nodules at pylorus. Healed ulcer scar in pylorus. Old perforated duodenal ulcer invading pylorus	Benign peptic ulcer. Adenocarconoma of pylorus	Died 9 days postoperatively from respiratory infection	1
Partial gastric resection	Extrabiliary mass infiltrating pylorus secondarily	Adenocarcinoma of extrabiliary tract. Invasion of stomach secondarily	Lived approximately 1 year. Jaundiced at termination	2
Subtotal gastrectomy. Polya anastomosis and jejunostomy	Dense adhesions. Old perforated peptic ulcer at pyloric tip. Stenosis at pylorus. Stenosis at gastroenterostomy stoma	Chronic hypertrophic gastritis. Old perforated gastric ulcer	Living and well	3
Subtotal gastric resection	Ulcer of duodenum 1 cm. from pyloroduodenal junction	Chronic gastritis	Living and well	4
Vagotomy. Pyloroplasty	Old perforated duodenal ulcer with healing. Ulcer in duodenum	None	Died after 16 months from cardiovascular failure	5
Gastric resection	Acute gastric ulcer with perforation, adhesions, cicatricial stenosis of pylorus	Chronic gastric ulcer	Living and well	6
Posterior gastroenterostomy	Duodenal ulcer with cicatrization. Thickening at the pyloric ring	None	Died 7 days postoperatively from upper respiratory infection	7
Anterior gastroenterostomy. Separation of adhesions	Multiple adhesions with scarring at the pylorus. Questionable carcinoma with fixation to adjacent organs	None	Died one year later from cardiovascular disease and failure	8
Anterior gastroenterostomy	Complete obstruction at pylorus due to an ulcer	None	Died 11 days postoperatively from cardiorenal failure	9
Anterior gastroenterostomy	Thickening at the pylorus with cicatrix and obstruction. Duodenal ulcer	None	Living and well	10
Bowel resection	General peritonitis. Closure of internal fistula	None	Died from other causes	11
No operation, because of coronary disease	No operation	None	Died from coronary occlusion	12
Posterior gastroenterostomy	Large dilated stomach. Old duodenal ulcer with stenosis of the pylorus	None	Living and well	13
Anterior gastroenterostomy	Pyloric stenosis with scarred ulcer of duodenum. Chronic cholecystitis and cholelith	None	Died 11 months later from cardiovascular failure	14
Posterior gastroenterostomy	Firm white tumor mass at pylorus. Firm irregular nodes in mesentery and studding of liver. Dilated stomach	No evidence of neoplasm on biopsy	Died 8 weeks after operation. Death felt due to carcinoma	15
Pyloroplasty and jejunostomy	Thickened and edematous pylorus	Chronic gastritis and hypertrophy of muscularis	Living and well	16
Gastric resection	Adhesions and old perforated duodenal ulcer	Chronic gastritis	Living. Has jaundice thought to be due to adhesions	17
Gastric resection	Scarred duodenal ulcer. Pyloric end of stomach indurated and partially obstructed. Many adhesions about pylorus and duodenum	Severe chronic hypertrophic gastritis. No evidence of ulcer	Living and well	18

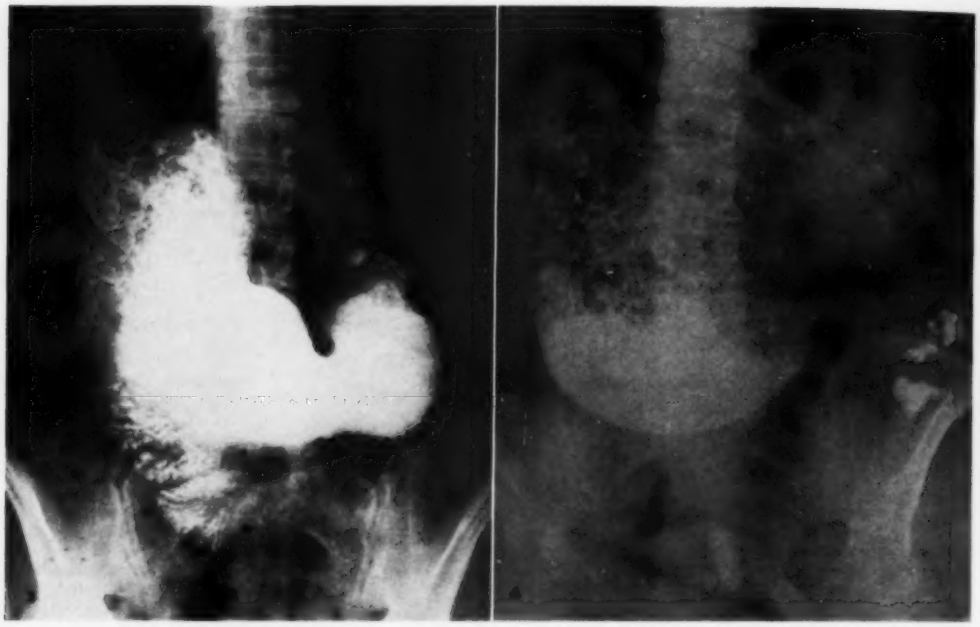

Fig. 3. Case II. The "bezoar-like" defects are due to retained food particles. Note the extreme size of the stomach, which seems pulled to the right. The pylorus and poorly filled bulb are in close relation to the viscera in the right upper quadrant. Some of the barium has entered the proximal jejunal loops.

Fig. 4. Case II. Note the "half-moon" appearance of the gastric residue at six hours. The mottled appearance in the proximal portion of the stomach is striking. Very little barium can be seen in the small intestine and what is present is irregularly scattered, indicating the severity of the pyloric obstruction and the irregular evacuation.

dration obscured the disclosure of any anemia, which is often significant in a gastric pyloric carcinoma.

CASE II: N. S., white female, age 70, for approximately five years had digestive symptoms, which were becoming more severe and discomforting. For the past three months, the patient complained of what she termed "gas pains," with bloating, and these had become increasingly marked. Bouts of nausea and vomiting had also occurred. A weight loss of 20 pounds had been noted within the last several months.

Prior to admission to the hospital, an upper gastrointestinal study in our office revealed "marked hypersecretion with a large gastric retention of fluids and food particles. The stomach was extremely large . . . showing diminished tone, and appeared pulled to the right. The gastric rugae were poorly delineated and seemed flattened. A static area at the pyloric ring with some deformity of the bulb was noted. Peristalsis was sluggish, later quite active with antral distention (Fig. 3). Six-hour study showed a pronounced gastric retention with a 'half-moon' appearance of the gastric residue (Fig. 4)."

A diagnosis of a benign pyloric obstruction with evidence of a peptic ulcer at the pyloric ring or at the base of the bulb was submitted.

On admission to the University Hospital, Columbus, Ohio, the upper gastrointestinal series was repeated, with the following report: "The stomach shows a bezoar of some type of pulpy material. The duodenal bulb filled. The small bowel pattern could only be partially outlined . . ." The one pertinent physical finding was a slightly enlarged liver. The only laboratory finding of any significance was a blood urea nitrogen of 18.5 mg. per 100 c.c. Other tests were within normal limits.

Six days after admission, a partial gastric resection was performed, with removal also of a metastatic tumor above the pancreas and partial removal of carcinomatous tissue in the region of the gallbladder. The dilated stomach was full of a thick grumous material which could not have been aspirated with a tube. There was an obvious carcinoma which had pulled the region of the pylorus against the gallbladder and into the liver. The tumor involved the stomach, and the gallbladder was completely replaced by cancer. On the basis of the histologic appearance, the primary lesion appeared to have its origin in the gallbladder or extrahepatic biliary tract, invading the stomach secondarily.

The patient lived approximately one year, toward the end of which she was severely jaundiced.

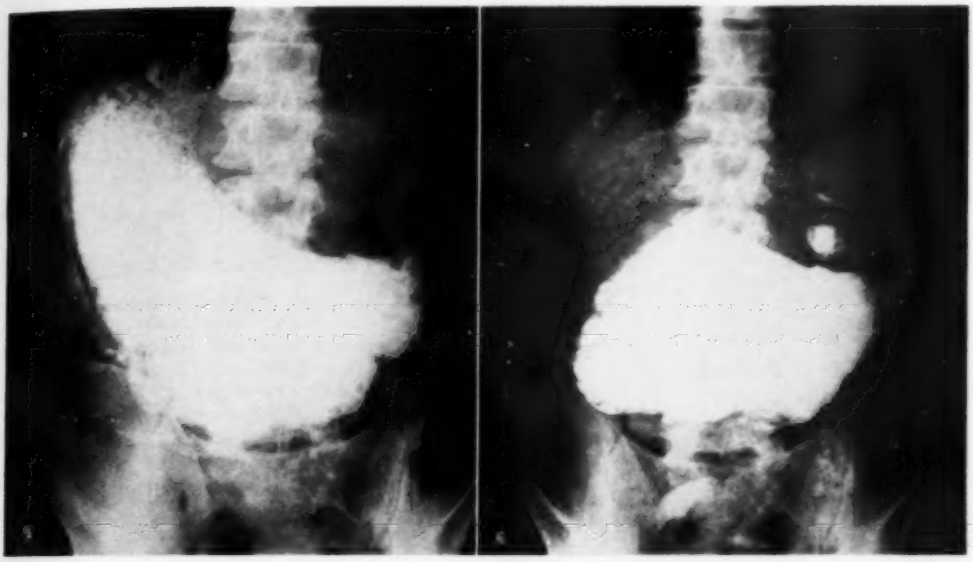

Fig. 5. Case III. Observe the decompensated stomach with but little if any barium passing through the pyloric ring. Radiopaque sutures can be seen in the upper abdomen from previous surgical intervention. A gastroenterostomy was said to have been performed, but the stoma has apparently closed, as no contrast medium can be seen entering a jejunal loop.

Fig. 6. Case III. The paucity of radiopaque material in the small intestine, the appearance of quiescence of the stomach, and the pronounced gastric retention are the outstanding impressions on the six-hour study.

Remarks: The discovery of an extragastric cancer, arising from either the gallbladder or extrahepatic biliary tract and secondarily invading the stomach, proved to be one of the exceptions to our concept that a chronic pyloric obstruction with gastric decompensation is primarily due to a benign peptic ulcer. The radiographic findings are identical with those noted in our proved benign ulcer cases. The question that comes to mind is: Could a differentiation have been made between this metastatic neoplastic involvement of the pylorus and changes due to a benign peptic ulcer? Reviewing the roentgen gastric pathology and the clinical manifestations, we were unable to ascertain any differences between this case and other cases in our series which had benign ulcer backgrounds.

CASE III: D. F., white male, age 42, was admitted to the hospital complaining of bloating and belching after meals for two to three months, epigastric fullness, and intermittent vomiting at night without associated nausea for one month. This patient gave a typical pain-food-relief ulcer history, with temporary response to a gastroenterostomy sixteen years earlier. Mild obstructive symptoms developed three years after the gastroenterostomy, for which a laparotomy was done, relieving obstruction due to adhesions. About eight months after this operation, the patient had a profuse gastric hemorrhage, which was treated conservatively. Following the hemorrhage, he was placed on a Sippy diet, with six months of complete rest. He had since been on a diet intermittently, with vague symptoms, until the onset of the present illness six months prior to admission. For the past month, he had experienced occasional nocturnal vomiting of food which had been eaten at dinner. These episodes of vomiting became progressively more frequent, having occurred each night for the past two weeks. The vomiting had not been associated with nausea or pain, and there was no recent history of melena or hematemesis.

Physical examination was essentially negative except for a large tympanitic area in the upper abdomen, which was thought to be a dilated stomach. The laboratory findings, including a complete blood count, determinations of total protein, prothrombin, and blood urea nitrogen, and urinalysis, were within normal limits. The preoperative hematocrit was 54 per cent. Gastric analysis showed a rather high acid value.

Roentgen examination prior to admission to the hospital demonstrated a pronounced hypersecretion in the pars cardia of the stomach. The stomach was

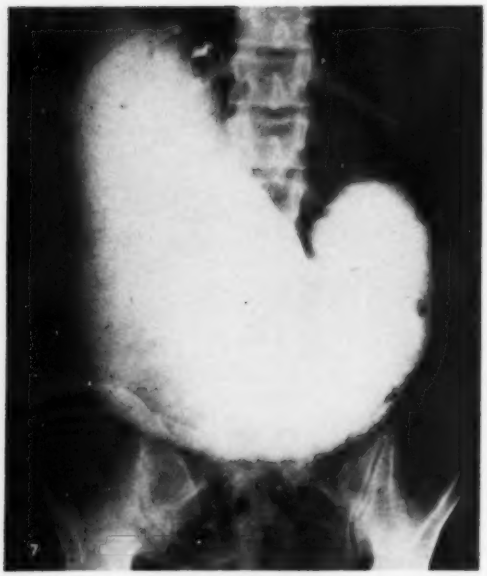

Fig. 7. Case IV. The huge bag-like stomach seems to fill most of the abdominal cavity. The pylorus is displaced to the right and the pyloric tip is in apposition with the liver margin. The gastric decompensation is evident, with what appears to be a lack of peristalsis.

quite large, with diminished tone. There was considerable antral distention. The bulb was poorly visualized. The previous gastroenterostomy showed little evidence of functioning, and no medium could be seen passing through the stoma. Peristalsis was quite active in the pyloric region; later the stomach was quiescent. The antral distention was prominent, with obstruction at the pyloric end of the stomach. The proximal loops of the jejunum showed no filling, due to the lack of barium in the small intestinal tract (Fig. 5). The six-hour examination revealed a marked gastric residue (Fig. 6). A diagnosis of benign postpyloric obstruction due to an old duodenal ulcer was made. The studies were repeated in the hospital with identical findings.

A subtotal gastric resection with a jejunostomy was performed four days after admission. Dense adhesions attached the left lobe of the liver to the peritoneum as well as the omentum. The omentum was also anchored to the region of the pylorus and up to the hilus of the liver as the result of an old perforation. The area of the pylorus just adjacent to the pyloric vein was quite stenosed and indurated, and the pancreas seemed to be hard about this site. The gastrojejunal stoma did not admit more than the little finger and there appeared to be a great deal of induration about this site.

Inspection of the pyloric area revealed no evidence of ulcer, but the wall was 0.75 cm. in thickness and fibrotic. The microscopic diagnosis was chronic hypertrophic gastritis.

The patient is alive and well at time of writing.

Remarks: This case demonstrates the typical roentgen findings so often noted in pyloric obstruction due to a benign peptic ulcer, in spite of a gastroenterostomy. A pronounced occlusion of the gastrojejunal stoma permitted the occurrence of the classical features.

CASE IV: J. C., a white male, age 26, was hospitalized about two years earlier for what was thought to be a perforated peptic ulcer, following a bout of severe abdominal pain. He was not surgically explored but was placed on an ulcer régime. Periodically, for the past three months, he had experienced episodes of abdominal pain, nausea, and vomiting; occasionally tarry stools were observed. From time to time, there were bouts of upper epigastric distress. A weight loss of 30 pounds had occurred since the onset of symptoms.

A previous hospital admission several weeks earlier and a subsequent gastrointestinal tract series demonstrated gastric dilatation with marked hypersecretion in the stomach. "The antrum of the stomach showed considerable dilatation. The duodenal bulb never filled well (Fig. 7). At six hours there was more than 95 per cent retention of barium in the stomach, with but a slight scattering in the small intestines." A stenosing lesion of the duodenum due to an old duodenal ulcer was the diagnosis tendered.

Two days after his second admission to the hospital the patient had a subtotal gastrectomy. Prior to surgery, the physical examination revealed no remarkable findings except for some tenderness in the epigastric region. The hemoglobin was 75 per cent. Otherwise the laboratory findings were all within normal limits.

At operation the stomach was found to be greatly dilated, with a stenosing ulceration on the inferior margin of the duodenum approximately 1.0 cm. past the pyloroduodenal junction. The mucosa showed only slight superficial congestive changes. The stomach wall revealed some edematous thickening but there was no suggestion of tumor growth. The diagnosis, after microscopic examination, was chronic atrophic gastritis, with no evidence of malignancy.

The patient made an uneventful recovery and is alive and well.

Remarks: The benign peptic ulcer responsible for the obstructive findings typifies the majority of cases in our series. We were reasonably sure that the offending mechanism was a benign ulcer in view of the clinical aspects of the case and the patient's age.

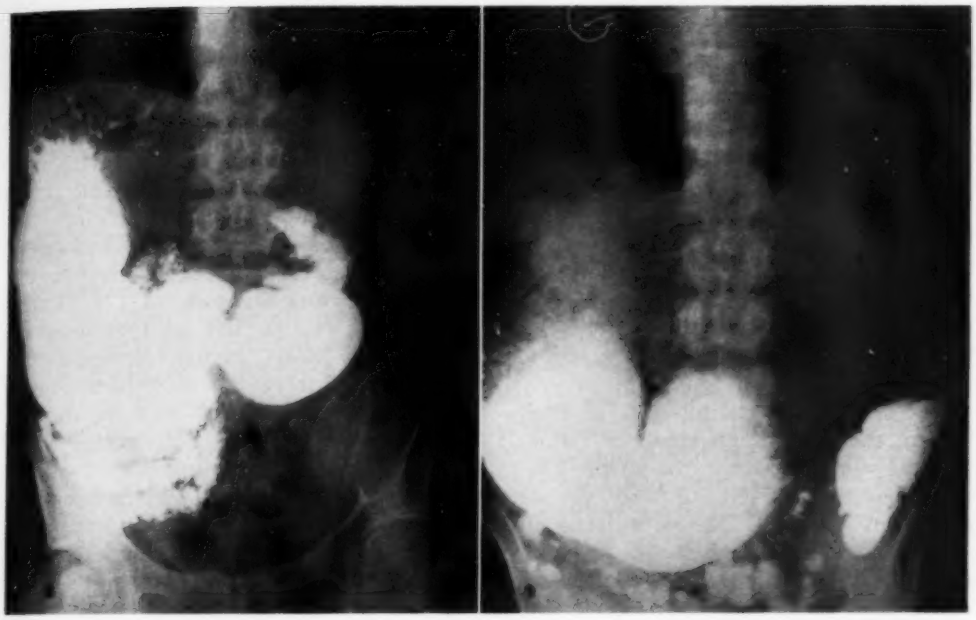

Fig. 8. Case V. The deep forceful contractions in the antral region seem to be attempting to push the barium through the pyloric obstruction. Sufficient contrast medium has been expelled beyond the stenosis to demonstrate a deformed constricted duodenal bulb.

Fig. 9. Case V. The retention at the end of twenty-four hours is unusually large, and gastric quiescence can be noted.

CASE V: J. H., a 63-year-old colored male, was admitted to the University Hospital at Columbus, Ohio, because of progressive symptoms of obstruction of the upper gastrointestinal tract. For three months prior to admission, his discomfort was described as fullness, cramps, and "gas" formation following eating. Relief was obtained by taking alkalies but not with ingestion of food. Vomiting relieved some of the distress. In the beginning, the patient vomited infrequently, but at the time of admission to the hospital, he was vomiting daily the meals taken on the preceding day. Close questioning revealed a history of "stomach trouble" for several years.

An x-ray examination of the upper gastrointestinal tract previous to hospital admission showed the stomach to be "extremely large with marked dilatation . . . . There was 'peaking' at the pyloric tip with a definite obstruction at the pyloric ring. The bulb was poorly visualized, with a suggestive cloverleaf deformity . . . . Antral distention was quite outstanding (Fig. 8). On the six-hour study, there was a marked gastric retention. The barium was irregularly scattered in the small intestinal tract. At twenty-four hours, there was still a pronounced gastric residue with antral distention noted (Fig. 9)." The diagnosis was benign pyloric obstruction, probably with a callous ulcer invading the pyloric ring.

Physical examination demonstrated an enlarged heart, with a systolic murmur at the apex. A large right hydrocele was also found. Admission blood and urine studies were normal. Serologic tests were positive for syphilis, and the spinal fluid showed a paretic type of curve. A twelve-hour night specimen of gastric secretion revealed a volume of 860 c.c., with 50 degrees of free hydrochloric acid. The sedimentation rate was 55 mm. in one hour.

Two repeat roentgen studies in the hospital demonstrated what was felt to be an organic pyloric obstruction with a persistent small defect in the antrum.

Eleven days after hospital admission a vagotomy and pyloroplasty were performed. The surgical report was as follows: "A large edematous stomach was found with what appeared to be an ulcer on the superior surface of the first portion of the duodenum. There was considerable edema of the stomach wall . . . . An ulcer was found at the junction of the pylorus and the duodenum on the duodenal side, and this appeared to have perforated and sealed over."

The patient made an uneventful recovery and was discharged from the hospital. He died sixteen months later from cardiovascular failure.

Remarks: Our opinion, prior to surgical substantiation, was that we were dealing

with a benign pyloric obstruction, probably on an ulcer basis. There was also some preliminary question of cancer in view of the age of the individual, and of the possibility of syphilitic involvement. The latter is extremely rare.

DISCUSSION

In conjunction with abstract speculations, comments are offered in an attempt to justify some of the more pertinent clinical manifestations and roentgen findings of pyloric obstruction and gastric decompensation.

The vomiting is attributed to an excitation of the afferent terminals of the vagi and the sympathetics in the stomach with impulses transmitted to the vomiting center in the medulla, as well as substances carried through the blood stream affecting this same center. The flaccid stomach is compressed by a rise in intra-abdominal pressure due to a descent of the diaphragm and contraction of the abdominal muscles. These in turn attempt to raise the intragastric pressure. The vomiting is responsible for the loss of body water and chlorides, with reduction in the body electrolytes, leading to an alkalosis, dehydration, and an azotemia. As is known (7, 10, 19, 26, 31), any withdrawal of the electrolytes of the body fluids, primarily sodium, potassium, and chloride ions, either extracellular or intracellular, will be accompanied by a proportionate reduction in volume of body water, resulting in an alkalosis. The alkalosis in turn sponsors a renal insufficiency. The alteration of the fluid balance and electrolyte metabolism instigates a depression of the renal plasma flow and a decreased glomerular filtration. Dehydration promotes a diminution of fluids available for excretory purposes and decreases blood flow while increasing protein destruction and the colloidal osmotic pressure of the blood (9, 11, 26, 31, 33). The azotemia can be and probably is responsible for the neurologic manifestations.

The accumulation of gastric fluids due to organic obstruction is from ingested liquids and gastric secretions, representing a corresponding loss of water and chlorides from the stores of the body. The stomach, unable to absorb its own secretions, becomes increasingly distended, and the increasing distention acts as a stimulus for further secretion and peristaltic activity (7). However, a neuromuscular hyperactivity independent of the presence of food in the stomach has been demonstrated in partial pyloric stenosis (13, 17). Later, extreme dilatation has an inhibitory influence on both gastric secretion and activity, and this latter phenomenon probably accounts in large measure for the long periods of quiescence occurring in the hugely dilated stomach. A wearied or exhausted response mechanism, or possibly even a raised threshold, may figure in the gastric effect. The impairment in tonus may be the result of several factors, such as a progressive loss in gastric elasticity from the prolonged over-distention, with elongation of the muscle fibers and reduction in muscle thickness, or some involvement of the nerve endings from intramural edema, or persistent stimulation. Many of these patients had taken large doses of alkalies and it has been experimentally shown that alkalies will produce immediate inhibition of tonus and gastric contractions when introduced into an empty stomach during hunger contractions (13). The tonus relaxation and prolongation of the quiescent period are even more pronounced if alkalies are introduced into a quiescent stomach. A deficiency in vitamin B components tends to promote anorexia and gastric atony, contributing to gastric retention (33). Air swallowing, intestinal gases, gastric fermentation, and even sometimes putrefaction account for the large *Magenblasse* in the cardiac end of the stomach and also play a part in the ballooning of the relaxed organ.

The elongation of the pyloric canal may be more apparent than real. The spacing between the stomach and the duodenum is due to the involvement of the prepyloric area, whether functional or organic. The

functional factor may be gastrospasm of either the muscularis propria or the muscularis mucosa, or both. Spasm produced by extragastric lesions will vary from time to time like pylorospasm. The organic factors may be an intramural edema and possibly some fibrosis, neoplastic invasion, adhesions with fixation, and stretching due to the dependent position of the stomach or the weight of retained material in the atonic stomach.

The apparent mid-line position of the stomach may be attributed to adhesions in the right upper quadrant of the abdominal cavity pulling the stomach to the right or to dependency of the tremendous dilated, atonic organ containing a prodigious amount of gastric fluids and material, or a combination of both factors. The dependency of the distended stomach with the retained fluid contents in conjunction with the impairment in tonus accounts for the "half-moon" appearance of the gastric residue noted at the six-hour upright examination.

In our small series of cases there were 12 in which it was certain that a benign peptic ulcer was the causative factor in the production of the pyloric obstruction with gastric decompensation, *i.e.*, an absolute figure of 66.6 per cent. Two cases we feel can be added to this group, raising the total to 14 or 77.8 per cent. In 1 of these cases there was a co-existing adenocarcinoma of the pylorus, but this was considered to be of insufficient size and extent to have effected the pronounced gastric changes. In the other case repeated roentgen examinations over a period of several years demonstrated a duodenal ulcer with eventual invasion of the pyloroduodenal junction, producing stenosis and obstruction with gastric insufficiency. This patient, however, died from a coronary occlusion before surgical intervention could be instituted. One case (5.5 per cent) was reported pathologically as a benign pyloric hypertrophy, although clinically the symptoms and response to therapy were those of ulcer. One proved extragastric carcinoma and 2 cases which the surgeons considered as malignant represent the remaining 16.6 per cent of the series. A node biopsy in 1 of the 2 latter cases showed no tumor, although there were multiple nodules in the liver and death, shortly thereafter, was considered to be of a "cancer" type. The other patient lived for one year and expired from cardiovascular failure.

It is our conclusion, therefore, that benign peptic ulcers are the predominant lesions producing chronic pyloric obstruction with consequent gastric decompensation. Other possibilities, however, cannot be excluded, such as malignant neoplasms, extrinsic or intrinsic, and certain entities which can occasionally duplicate the clinical and roentgen picture.

SUMMARY

A review of the literature revealed conflicting opinions and impressions as to the etiologic factors producing pyloric obstruction with profound gastric distention. The clinical and roentgen findings in the reported cases are summarized.

A further series of 18 cases is presented in tabular form and histories of 5 of these cases are included. This series showed practically identical roentgen findings—pyloric obstruction and a greatly dilated atonic stomach with gastric retention at six and twenty-four hours. The radiologic observations were verified at operation in most of the cases.

In 12 cases (66.6 per cent) a benign peptic ulcer was established definitely as the cause of the pyloric obstruction and gastric decompensation, and in 2 others a benign ulcer was believed to be responsible.

On this basis it is concluded that benign peptic ulcer is the predominant lesion producing chronic pyloric obstruction with gastric decompensation but that roentgenologically specificity cannot be claimed for any one lesion.

An explanation for some of the clinical symptoms and roentgen findings is attempted.

36 West Locust St.
Newark, Ohio

REFERENCES

1. ALEXANDER, F. K.: The Prepyloric Suspect Lesion. Radiology **61**: 523–533, October 1953.
2. ALVAREZ, W. C.: Cited by Golden (20).
3. ANDERSON, W. A. D., editor: Pathology. St. Louis, C. V. Mosby Co., 1948, p. 824.
4. BABKIN, B. P.: Secretory Mechanism of the Digestive Glands. New York, Paul B. Hoeber, Inc., 2d ed., 1950, pp. 72–141.
5. BARCLAY, A. E.: The Digestive Tract. London, Cambridge Univ. Press, 2d ed., 1936, pp. 147–162, 266–267.
6. BELL, E. T., editor: Textbook of Pathology. Philadelphia, Lea & Febiger, 6th ed., 1947, p. 531.
7. BEST, C. H., AND TAYLOR, N. B.: The Physiological Basis of Medical Practice. Baltimore, Williams & Wilkins Co., 4th ed., 1945, pp. 432–436, 484–487, 489, 511.
8. BOYD, W.: Surgical Pathology. Philadelphia, W. B. Saunders Co., 6th ed., 1947, pp. 228–232.
9. BROWN, G. E., AND OTHERS: Toxic Nephritis in Pyloric and Duodenal Obstruction: Renal Insufficiency Complicating Gastric Tetany. Arch. Int. Med. **32**: 425–455, September 1923.
10. BURNETT, C. H., BURROWS, B. A., COMMONS, R. R., AND TOWERY, B. T.: Studies of Alkalosis. II. Electrolyte Abnormalities in Alkalosis Resulting From Pyloric Obstruction. J. Clin. Investigation **29**: 175–186, February 1950.
11. BURNETT, C. H., BURROWS, B. A., AND COMMONS, R. R.: Studies of Alkalosis. Renal Function During and Following Alkalosis Resulting From Pyloric Obstruction. J. Clin. Investigation **29**: 169–174, February 1950.
12. CANTAROW, A., AND TRUMPER, M.: Clinical Biochemistry. Philadelphia, W. B. Saunders Co., 3d ed., 1946, p. 477.
13. CARLSON, A. J.: The Control of Hunger in Health and Disease. Chicago, Univ. Chicago Press, 1916, pp. 177, 278.
14. CARMAN, R. D.: The Roentgen Diagnosis of the Diseases of the Alimentary Canal. Philadelphia, W. B. Saunders Co., 2d ed., 1920, p. 156. Roentgenology. Baltimore, Wm. Wood & Co., 2d ed., 1935, p. 535.
15. Cunningham's Textbook of Anatomy. New York, Oxford Univ. Press, edited by J. C. Brash, 9th ed., 1951, pp. 609–620.
16. DRAGSTEDT, L. R., OBERHELMAN, H. A., JR., AND WOODWARD, E. R.: Physiology of Gastric Secretion and Its Relation to the Ulcer Problem. J.A.M.A. **147**: 1615–1620, Dec. 22, 1951.
17. ELSESSER, O. J.: The Effect of Experimental Stenosis of the Pylorus on Tonus and Contractions of the Empty Stomach. Am. J. Physiol. **39**: 303, 1915.
18. FELDMAN, M.: Clinical Roentgenology of the Digestive Tract. Baltimore, Williams & Wilkins Co., 3d ed., 1948, p. 152.
19. GAMBLE, J. L., AND ROSS, G. G.: Cited by Lans *et al.* (26).
20. GOLDEN, R., editor: Diagnostic Roentgenology. New York, Thomas Nelson & Sons, 1948, Vol. I. pp. 291–303, 307, 340H.
21. GRAY, H.: Anatomy of the Human Body. Edited by C. M. Goss. Philadelphia, Lea & Febiger, 1948, pp. 1207–1213.
22. HARRIS, M. L.: Cited by Jenkinson (23).
23. JENKINSON, E. L., PFISTERER, W. H., NORMAN, R. C., AND LATTEIER, K. K.: Perigastric Adhesions and Bands Involving the Pyloric Antrum. A Diagnostic Enigma. Am. J. Roentgenol. **67**: 210–215, February 1952.
24. KARSNER, H. T.: Human Pathology. Philadelphia, J. B. Lippincott Co., 7th ed., 1949, p. 571.
25. KÖHLER, A.: Roentgenology: The Borderlands of the Normal and Early Pathological in the Skiagram. 2d English Edition Translated and Edited by Arthur Turnbull. Baltimore, Wm. Wood & Co., 1935, p. 535.
26. LANS, H. S., STEIN, I. F., JR., AND MEYER, K. A.: Electrolyte Abnormalities in Pyloric Obstruction Resulting from Peptic Ulcer and Gastric Carcinoma. Ann. Surg. **135**: 441–453, April 1952.
27. LAUER, B. R.: The Effect of Pyloric Stenosis on Human Gastric Motility. Master's Thesis, Ohio State University, 1937, pp. 11–12.
28. MCCANN, J. C., AND DEAN, M. A.: Hypertrophy of Pyloric Muscle in Adult. Surg., Gynec. & Obst. **90**: 535–542, May 1950.
29. MAXIMOW, A. A., AND BLOOM, W.: A Textbook of Histology. Philadelphia, W. B. Saunders Co., 4th ed., 1944, pp. 396–405.
30. MEYER, W. H.: The Importance of Roentgen Gastric Functional Study in the Differential Diagnosis of Pyloric Lesions. Radiology **24**: 206–212, February 1935.
31. NOTH, P. H., AND WILBUR, D. L.: Chemical Changes in the Blood of Patients with Pyloric Obstruction. Ann. Int. Med. **13**: 1285–1296, February 1940.
32. PILLMORE, G. W.: Clinical Radiology. A Correlation of Clinical and Roentgenological Findings. Philadelphia, F. A. Davis Co., 1946, Vol. I, p. 512.
33. PORTIS, S. A.: Diseases of the Digestive System. Philadelphia, Lea & Febiger, 2d ed., 1946, pp. 110–139, 253.
34. STONE, R. S., AND RUGGLES, H. E.: The Diagnostic Value of Prepyloric and Pyloric Roentgen Findings. Am. J. Roentgenol. **27**: 193–204, February 1932.
35. TAYLOR, A. S.: Cited by Jenkinson (23).
36. WRIGHT, S.: Applied Physiology. New York, Oxford Univ. Press, 6th ed., 1937, pp. 556, 561.

SUMARIO

Lesiones con Síntomas Crónicos que Producen Oclusión Pilórica y Descompensación Gástrica

Un repaso de la literatura reveló opiniones e impresiones contradictorias en cuanto a los factores etiológicos que producen oclusión pilórica con profunda distensión gástrica. Sumarízanse aquí los hallazgos clínicos y roentgenológicos en los casos publicados.

Preséntase una serie nueva de 18 casos en forma tabular, junto con las historias de 5 de estos casos. Esta serie mostró hallazgos radiológicos prácticamente idénticos: oclusión pilórica y considerable dilatación y atonía gástrica, con retención de seis y de venticuatro horas. En la mayor parte de los casos, se comprobaron en la operación las observaciones radiológicas.

En 12 casos (66.6 por ciento), se estableció definitivamente que una úlcera péptica benigna era la causa de la oclusión pilórica y la descompensación gástrica, y en otros 2 una úlcera benigna también parecía ser la causa. En un caso se comunicó histopatológicamente hipertrofia pilórica benigna y en otro carcinoma extragástrico. En los 2 casos restantes, la impresión del cirujano fué cáncer, aunque no se obtuvo confirmación histopatológica.

A base de lo anterior, se deduce que la úlcera péptica benigna es la lesión predominante que produce oclusión pilórica crónica con descompensación gástrica, pero que, roentgenológicamente, no cabe reclamar especificidad para ninguna lesión dada.

Esbózase una explicación de algunos de los síntomas clínicos y hallazgos radiológicos.

Gastric Lymphoma[1]

GORDON J. CULVER, M.D., BERTEN C. BEAN, M.D., and DAVID L. BERENS, M.D.

THE MALIGNANT lesions of the stomach originate in three of its structural components: the mucous membrane, the lymphoid tissues, and the muscle coats. Over 98 per cent are carcinomas, which arise from the mucous membrane; less than 2 per cent are lymphomas, which arise in the lymphoid tissues; about 0.1 per cent are leiomyosarcomas, arising from the smooth muscle.

In an earlier article, one of us reported 2 cases of Hodgkin's disease of the stomach (16). Subsequently we have demonstrated several gastric lesions which on microscopic examination proved to be lymphomas. The similarity of these cases prompted this review of the clinical and roentgen findings in cases of gastric lymphoma.

Diseases of the lymphoid structures, perhaps due to their obscure origins and complex histologic patterns, have been encumbered with a confusion of terminology which makes a simple classification most difficult. The term lymphoma includes all uniformly fatal diseases of the lymphoid tissue. In the stomach the fundamental pathological process is an infiltration of the gastric wall by cells of the lymphoid series, with associated regional lymph-node changes. The lymphomas which may involve the stomach are giant-follicle lymphoma, Hodgkin's disease, lymphosarcoma, and leukemia. Numerous reports have appeared under various titles, as Hodgkin's Disease, Sarcoma, Lymphosarcoma, Lymphoblastoma, Leukemia, Pseudoleukemia and Lymphoid Tumors, but no detailed analysis of the entire group has been published, nor has the similarity of gross pathological changes in the various conditions been emphasized.

The etiology of the lymphomas has never been determined and all attempts to transmit the disease experimentally have failed. Several theories have been advanced. The condition has been held to be (*a*) an atypical form of tuberculosis, (*b*) a specific infection by an unknown pathogenic microorganism, (*c*) a granuloma of unknown etiology, (*d*) a neoplastic disease (29).

The lymphomas account for less than 2 per cent of malignant gastric lesions. The highest incidence is in the fifth decade. The overall age incidence of Hodgkin's disease of the stomach is the same as the age incidence of Hodgkin's disease in general (greatest between eighteen and thirty-eight years). The average age of patients with lymphosarcoma is about forty-four years. Reticulum-cell sarcoma is relatively frequent under the age of thirty. Lymphoma of the stomach is found twice as often in males as in females. In general, the age group affected is younger than for gastric carcinoma.

A review of the normal anatomy and histology of the stomach and duodenum (Figs. 1 and 2) is beyond the scope of this paper but is necessary for a complete understanding of the site of origin and mode of extension of gastric lymphomas (18).

PATHOLOGY

Grossly three forms of gastric lymphomas may be described.

1. *Ulcerative:* There is submucosal infiltration with formation of small submucosal tumors extending into the mucosa. The ulcerations of leukemia tend to be very superficial.

2. *Tumor-like:* Nodular submucosal infiltration with poorly defined borders may occur; occasionally there are large everting lesions. The lymphosarcomas give rise to fairly well demarcated bulky lesions with arcuate borders.

3. *Diffuse:* The mucosa may be

[1] From the Department of Radiology, Buffalo General Hospital, Buffalo, N. Y. Accepted for publication in October 1954.

thrown up into large tortuous rugae studded with nodules.

Although the histologic pattern determines which of the lymphomas has involved the stomach, no attempt will be made to describe the complex differential features. Certain aspects of the microscopic picture will be discussed, since they explain some of the alterations in physiology observed by the roentgenologist.

The usual complications associated with carcinoma and peptic ulcer are infrequent in gastric lymphoma. Perforation and massive bleeding are unusual, since the ulcers are for the most part superficial and there is little necrosis; even in extensively involved areas the muscularis mucosae may be preserved. Pyloric obstruction is unusual because of the soft nature of the infiltrate, with little if any stroma. Fibrosis occurs late.

Giant-follicle lymphoma is characterized by the formation of numerous large follicles or germinal centers (1). The course is longer than for the other lymphomas and the response to radiation is more satisfactory. In the late stages, a change in structure may occur and the features of lymphosarcoma, lymphatic leukemia, or Hodgkin's disease may be present.

Hodgkin's disease is the most common lymphoma in the stomach, involving the pars pylorica most frequently. It originates in the lenticular glands and progresses from lymphoid hyperplasia to complete replacement of the normal lymphoid tissue by a polymorphocellular tissue which infiltrates the areolar submucosa

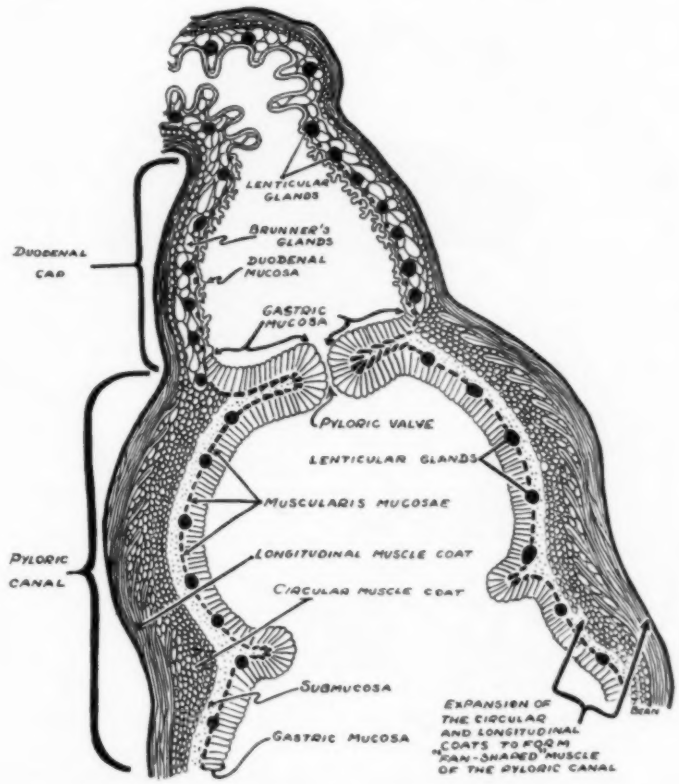

Fig. 1. Schematic drawing of cross section through pars prepylorica of the stomach and the pyloric valve. Redrawn from Cole.

and may extend through the muscularis externa to the serosa.

Lymphosarcoma is not a distinct cytologic entity but comprises two main forms: reticulum-cell sarcoma and malignant lymphocytoma (10, 26). This is the most malignant of the gastric lymphomas. Gastric lymphosarcoma has been reported secondary to a known primary focus in a distant part of the body. It is characterized by the roentgen appearance of a solitary malignant gastric lesion (4, 19). The abdominal nodes, omentum, gastric wall, spleen, and liver may be fused together.

Leukemic infiltration of the viscera is common in chronic lymphatic leukemia. Myelogenous leukemia may show lymph node enlargement and visceral infiltration. There is massive submucosal infiltration without destruction of the normal elements of the gastric wall.

Multiple segments of the gastrointestinal tract may be involved simultaneously. Duodenal lesions associated with lymphoma of the stomach are frequent. Martin (17) reported associated involvement of the duodenum in 75 per cent of a series of pyloric lymphomas reviewed up to 1935. This is in contrast to carcinoma of the stomach, which crosses the pyloric valve in only 5 per cent of cases. The extension of epithelial neoplasms of the stomach is, for the most part, through lymphatic pathways, and to a lesser extent through the submucosa. Apparently the lack of lymphatic anastomosis and discontinuity of the areolar submucosa at the junction of the stomach and duodenum in-

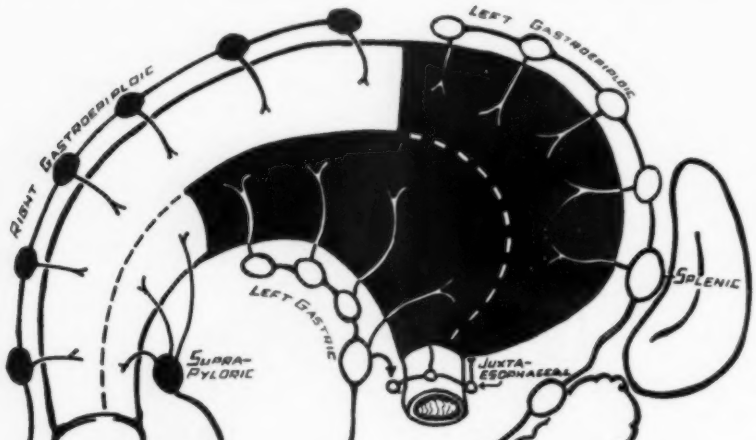

Fig. 2. Diagram of the large lymphatic trunks and lymph nodes of the stomach and first portion of the duodenum. The nodes in black represent the major lymphatic drainage of the pars prepylorica and the first and second portions of the duodenum. Those in white represent the major lymphatic drainage of the remainder of the stomach.

terposes a sufficient barrier to confine a carcinoma to the stomach. The lymphomas, on the other hand, arise in and spread extensively through the submucosa. Lenticular glands are abundant in the duodenum as well as the pyloric region (Fig. 1). Also, the lamina propria of the duodenal mucosa has many of the characteristics of lymphatic tissue. These factors would favor duodenal extension of a gastric lymphoma.

In an extensive gastrointestinal lymphoma the possibility of multicentric sites of origin with simultaneous involvement of lymphoid tissue in both the stomach and duodenum cannot be disregarded.

CLINICAL FINDINGS

The clinical findings are usually not diagnostic of lymphomas. Many patients are relatively symptom-free and in a good state of nutrition despite evidence of extensive involvement of the stomach. This is in direct contrast to the cachexia, debilitation, and symptomatic course of patients with equally extensive carcinoma of the stomach.

A palpable epigastric mass is found in 50 per cent of gastric lymphosarcomas (27). Occasionally gastric Hodgkin's disease, either primary or secondary, may show the Pel-Ebstein type of fever or daily fluctuations of temperature. In late stages, cachexia and anemia are as profound as in any terminal generalized lymphoma. Primary lymphomas of the stomach may be extensive without any evidence of peripheral adenopathy.

The gastric acidity is often lowered, but absence of free hydrochloric acid is not as common as in carcinoma. Achlorhydria occurs in 65 per cent of cases of gastric lymphosarcoma. With the exception of leukemia, the gastric lymphomas have no uniform or specific blood picture. Secondary anemia, leukocytosis, polynucleosis, or eosinophilia may occur.

ROENTGEN DIAGNOSIS

The radiologic features which characterize lymphomas of the stomach can best be described by referring to the types of gastric wall involvement encountered. Obviously any combination of the following five types may be present.

I. Multiple submucosal nodules with normal intervening gastric wall. Such lesions are difficult to demonstrate since they produce little elevation of the mucous membrane and no interference with peristalsis. They represent an early form, and the patient rarely presents himself for examination at this stage of the disease.

II. Localized plaque-like thickening of the gastric wall. Broad, flat, fairly well circumscribed wall lesions presenting an indented relief are characteristic.

III. Pseudopolypoid everting lesions, which may involve part or all of the stomach. Their borders are arcuate and any intervening areas of wall may be normal.

IV. Ulceration. Ulcers, particularly in Hodgkin's disease, are apt to be multiple and shallow. When large ulcers are demonstrated, their margins are sharply elevated, surrounding the base like a wall. Gradually sloping infiltration surrounds the crater, blending imperceptibly with normal mucous membrane.

V. Diffuse, giant rugal form. Thickening and distortion of rugae are the most characteristic findings. A small amount of contrast material best demonstrates this form. In about one-third of the cases rugae 1.0 cm. or more in width are described. A lesser degree of rugal thickening is often present. The wall is thickened, as shown by the displacement of the cardia from the left diaphragm (3, 13, 17, 21, 22, 25).

Peristalsis, though sluggish, may be present throughout the lesion, despite massive involvement. The soft nature of the infiltration, lack of fibrosis, and sparing of the muscularis mucosae account for the discrepancy between the degree of involvement and peristaltic activity (14, 15, 22, 24).

Double lesions about the pyloric valve must be diligently searched for. The commonest site of such involvement is the distal third of the stomach. All such le-

Fig. 3. Case I. Large ulcer crater arising in the pylorus and extending to the base of the duodenal bulb.

sions must be scrutinized carefully for any evidence that the pyloric valve has been crossed (15, 17, 21).

Lymphosarcoma and reticulum-cell sarcoma may also show a large mass with resultant displacement of the stomach. Such a mass in the presence of the previously mentioned findings would certainly favor a presumptive diagnosis of lymphosarcoma. Hepatic and lienal enlargement, if obvious, would favor lymphatic or aleukemic leukemia.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis is at times extremely difficult and may be impossible. In the absence of the relatively few diagnostic findings mentioned, the true condition may not be suspected until a biopsy is done.

Gastric carcinoma presents a most difficult diagnostic problem, though it rarely crosses the pyloric valve (2, 17). Superficial spreading carcinoma may stiffen and distort mucosal folds, but the rugal distortion is usually not as massive or widespread as in the lymphomas. Carcinomatous infiltration of the stomach usually obliterates peristalsis more than a lymphomatous infiltration. Obstruction is more frequent in carcinoma than in lymphoma.

Gastritis of the hypertrophic type presents an equally difficult diagnostic problem. Occasionally gastritis will show the marked distortion of folds so common in lymphoma. Multiple superficial ulcerations and fixation of the wall are also common in gastritis. Gastroscopy offers a valuable aid in the diagnosis of diffuse rugal fold hypertrophy, the gastroscopic findings being quite specific for both gastritis and lymphoma (11, 23).

Syphilis, tuberculosis, leiomyosarcoma, amyloid and lipoid infiltration may involve the stomach, but relatively rarely.

REPORT OF CASES

The 2 cases previously reported can be classified as the tumor-like form of gastric Hodgkin's disease. In both there were plaque-like, annular, submucosal infiltrations in the pars pylorica. Roentgen examination demonstrated irregular filling defects with fixation of the wall and narrowing of the lumen. We are presenting 9 additional cases proved histologically.

CASE I: A white housewife, aged 50, complained of postprandial epigastric pain, which was relieved by antacids and milk. There was some tenderness in the epigastrium. Laboratory findings were within normal limits.

An upper gastrointestinal series performed on Sept. 15, 1950, revealed a large ulcer crater 2.5 cm. in diameter at the pyloric canal, which distorted and invaded the base of the duodenal bulb (Fig. 3). Peristalsis was uninhibited up to the lesion. No obstruction was encountered. The possibility of an ulcerating lymphoma was suggested.

At operation the prepylorus, pylorus, first portion of the duodenum, and head of the pancreas were found to be involved in a mass with considerable inflammatory reaction. *Pathologic diagnosis:* Giant-follicle lymphoma.

The patient received external irradiation to the epigastrium. She was readmitted three times for blood transfusions, the last recorded date being April 23, 1953, when she was discharged as improved but with persistent evidence of disease.

CASE II: A white housewife, aged 31, was admitted with a history of epigastric distress and dull

burning pain occurring intermittently for seven and one-half years. Physical and laboratory findings were within normal limits.

Roentgen examination (Fig. 4), after administration of barium by mouth, showed destruction of the mucosal markings starting on the lesser curvature of the stomach about 1 inch from the pylorus, extending up along the lesser curvature about 2 inches, and onto the posterior wall down to the greater curvature, which was fixed. Although there was evidence of a large lesion, fixation of the gastric wall was not complete throughout the lesion. After four hours, a moderate residue remained in the stomach. The roentgen interpretation was: "Malignant new growth; from the nature of the lesion suspect lymphoma, possibly Hodgkin's."

Operation revealed a grossly malignant process involving the lesser curvature, extending about 1 inch from the pylorus, with enlarged nodes along the lesser curvature to the hiatus and on the gastrocolic omentum. *Pathological report:* Lymphoma of the Hodgkin's disease type.

The patient was well and without evidence of recurrence in January 1950, when last examined.

CASE III: A white housewife, aged 39, was seen with a history of weakness for three and one-half years, epigastric pain for two years, and fever, chills, headache, and anorexia having their onset three weeks before admission. She had been treated for pernicious anemia and "ulcer at outlet of stomach" in 1947. The temperature was 103°, with daily elevation to 104°; pulse 110; respirations 25. Although acutely ill, the patient showed no evidence of weight loss. No peripheral adenopathy was observed. Moist râles were present throughout the chest. The abdomen was distended and there was a tender mass in the left upper quadrant. The liver edge was not palpable.

Laboratory findings were as follows: red blood count 3,000,000; hemoglobin 3 gm.; white blood count 17,000, with a moderate left shift, macrocytic anemia, suggestion of hypochromia, rare normoblasts. On blood culture, *B. pyocyaneus* was recovered on the third day.

Roentgen examination of the stomach and duodenum (Fig. 5), after oral administration of barium, showed fixation and patchy mucosal destruction involving the cardia and subcardial portions, extending down past the mid-stomach. Near the mid-stomach, on the posterior wall, was a sessile filling defect. Slightly higher on the posterior wall irregular ulceration was noted. The roentgen interpretation was: "Malignancy; the type of lesion demonstrated has been seen in Hodgkin's disease and we would entertain that diagnosis."

An infiltrating malignant tumor involving most of the gastric wall was found at operation, with large nodes along the greater curvature and infiltration into the gastrocolic ligament. *Pathological report:* Hodgkin's sarcoma.

Fig. 4. Case II. Irregular deformity of prepyloric area.

Fig. 5. Case III. Oblique view showing rugal fold distortion and sessile filling defect in mid-stomach.

The patient died on the first postoperative day. Autopsy showed massive intra-abdominal hemorrhage, Hodgkin's disease of the left kidney, liver, periaortic nodes, and inguinal and axillary nodes, with nodular infiltration along the suture line in the stomach.

CASE IV: A white housewife, aged 48, was admitted on Sept. 18, 1951, complaining of loss of ap-

Fig. 6. Case IV. Extensive infiltration of lesser curvature, pars cardia, and pars media.

petite and a 35-pound weight loss during the past three months. Physical and laboratory findings were essentially within normal limits.

An upper gastrointestinal roentgen examination performed on Sept. 14 (Fig. 6) showed the cardia of the stomach, from the cardioesophageal junction to the angle, to be involved in an infiltrative process, with fixation and destruction of the mucosal pattern, especially along the lesser curvature. There appeared to be submucosal extension, giving rise to giant rugal folds. The impression was: "Neoplasm, gastric—the possibility of lymphoma to be considered."

At operation a large soft-tissue mass was found, involving the cardia of the stomach and extending to the celiac axis and gastrohepatic ligament. *Pathologic report:* Hodgkin's sarcoma.

The patient was readmitted on Jan. 18, 1952, because of progressive weakness. She continued to decline in spite of supportive measures and chemotherapy and died on March 6 with generalized disease. Autopsy was not obtained.

CASE V: A white male, aged 64, was admitted March 11, 1954, with a history of epigastric pain during the past year and a weight loss of 25 pounds. In the epigastric region was a large hard mass, tender to palpation. It moved with respiration. Blood and urine studies were negative.

An earlier upper gastrointestinal series, Dec. 31, 1953 (Fig. 7A), had shown irregular polypoid filling defects involving the pars media and antrum and at least one small stellate crater of ulceration. Subsequent examination, Jan. 18, 1954, revealed healing of the ulcer previously described and marked decrease in the filling defects. Re-examination on March 11, 1954 (Fig. 7B), demonstrated a large crater of ulceration on the lesser curvature measuring 5 cm. in length and 2 cm. in diameter. It was surrounded by a large doughnut-shaped fold of gastric wall infiltration. Many large rugal folds were present in the pars media. The diagnosis was lymphoma.

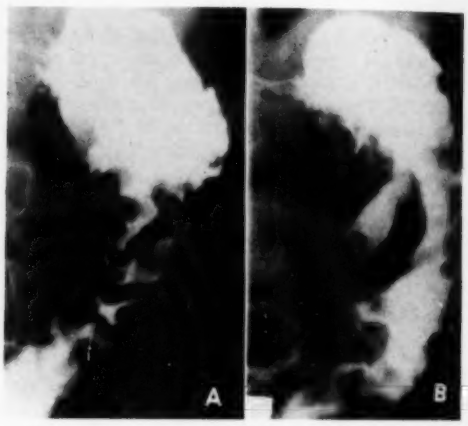

Fig. 7. Case V. A (Dec. 31, 1953). Irregular fold hypertropy. B (March 11, 1954). Large crater of ulceration.

A large fixed mass was found at operation, involving the upper three-fourths of the stomach, with extension to the celiac axis and aorta. There were multiple nodes in the omentum and mesentery of the small bowel. *Pathologic report:* Hodgkin's disease.

X-ray therapy was given to the epigastrium. During the course of irradiation, ascites developed, with probable seeding of the peritoneal cavity. The patient was discharged March 31 but was readmitted April 7 with marked ascites. In spite of supportive measures and nitrogen mustard, death ensued April 27. No autopsy.

CASE VI: A white male, aged 31, was admitted May 12, 1948, with a history of onset of sharp crampy pain, nausea, and emesis on March 29, 1948. There was persistent pain referred to the back, left chest, and left abdomen. Vomiting recurred and had become more severe in the past four days, with melena and hemoptysis. There had been a loss of 25 pounds in weight in five weeks.

Physical examination revealed an immovable mass the size of a melon in the left upper quadrant of the abdomen. The red blood count was 2,850,000; hemoglobin, 5.5 gm.; white blood count, 16,500, with 11 band forms, 70 filament types, 2 eosinophils, 12 lymphocytes, 4 monocytes, 1 plasma cell. A smear showed slight hypochromic anemia with polychromatophilia. The urine was normal.

Roentgen examination of the stomach, after

barium administration, showed forward displacement of the cardia and body by a large posterior extragastric mass. The stomach was also displaced to the left. In the posterior wall was evidence of submucosal infiltration, with production of very broad folds. The lesser curvature, 3 inches from the cardioesophageal junction, showed patchy mucosal destruction, with one area of ulceration. The extreme prepyloric region was not involved. There was no obstruction. The roentgen interpretation was: "Extragastric mass arising posterior to the stomach with secondary involvement of the posterior wall. Probably retroperitoneal lymphoma with secondary involvement of the stomach."

A retroperitoneal tumor was found at operation, extending through the gastrohepatic ligament, involving the posterior wall of the stomach and all of the posterior mesenteric lymph nodes extending over as far as the spleen and down to the region of the mesenteric vessels. *Pathologic diagnosis:* Lymphosarcoma.

The patient received one course of radiation therapy. He died in July 1948. No autopsy.

CASE VII: A white housewife, aged 39, complained of weakness, fever, and chills. She had no gastrointestinal complaints on admission. Temperature was 100.5°, pulse 100, respirations 25. Râles were present throughout the left lower chest. There was irregular irregularity of the heart. The liver was enlarged two finger breadths below the costal margin. There were some epigastric tenderness and spasm. The left leg and arm showed residual weakness.

The red blood count was 3,630,000; hemoglobin 10 gm.; white blood count, 14,200. The smear showed evidence of hypochromic anemia. The stools were strongly positive for occult blood. The gastric contents also showed occult blood; there was no free hydrochloric acid. The Wassermann and Kahn tests were positive.

On roentgen examination (Fig. 9) the stomach showed a massive filling defect starting at the pylorus and involving the lower half of the stomach irregularly, complete fixation, a mass, and mucosal destruction. A few large folds extended into the mid-portion. There was 20 per cent gastric retention proximal to the filling defect after four hours. The roentgen interpretation was: "Massive neoplasm of the stomach."

The patient was in no condition to withstand surgery and, in spite of forced feeding, intubation, and transfusions, the course was generally downhill. Death occurred approximately four months after admission. At autopsy a malignant tumor was found involving the pyloric antrum, with associated enlargement of the gastric nodes. There was also a bilateral lower lobe pneumonia. *Diagnosis:* Giant reticulum sarcoma of the stomach.

CASE VIII: A white male, aged 51, gave a history of good health until 1936, when he began to experience pain two hours before eating. Blood was found in the stool. Pain continued until surgery was done at another hospital, in 1937, when an "inoperable cancer" was found. Following this the patient gradually gained weight (19 pounds) and epigastric distress became intermittent. Thereafter pain and weakness gradually increased until December 1944, when he was admitted to the hospital for study.

Fig. 8. Case VI. Oblique view showing displacement of stomach anteriorly and to left, due to large retrogastric mass and invasion of posterior wall.

The temperature was 100°, pulse 96, respirations 18, blood pressure 120/68. The epigastrium was full and tender. The liver was palpable two finger breadths below the costal margin. There was a healed mid-line scar above the umbilicus.

The red blood count was 3,400,000; hemoglobin, 9.29 gm.; white blood count, 11,000. A smear showed polychromatophilia.

On Dec. 15, 1943, a roentgen study of the stomach (Fig. 10) showed multiple polypoid filling defects just beyond the cardioesophageal junction, then a small area of normal stomach, and, in about the mid-portion of the stomach, a huge polypoid filling defect 8 cm. in length by 4 cm. in width. Distal to this defect the stomach appeared normal. The filling defects were fairly well circumscribed, with arcuate borders. The duodenum appeared normal. The roentgen interpretation was: "Multiple polypoid new growths involving the cardia and mid-portion of the stomach, with minimal destruction. The multiplicity in character would speak for benignancy."

Re-examination, March 21, 1944, showed con-

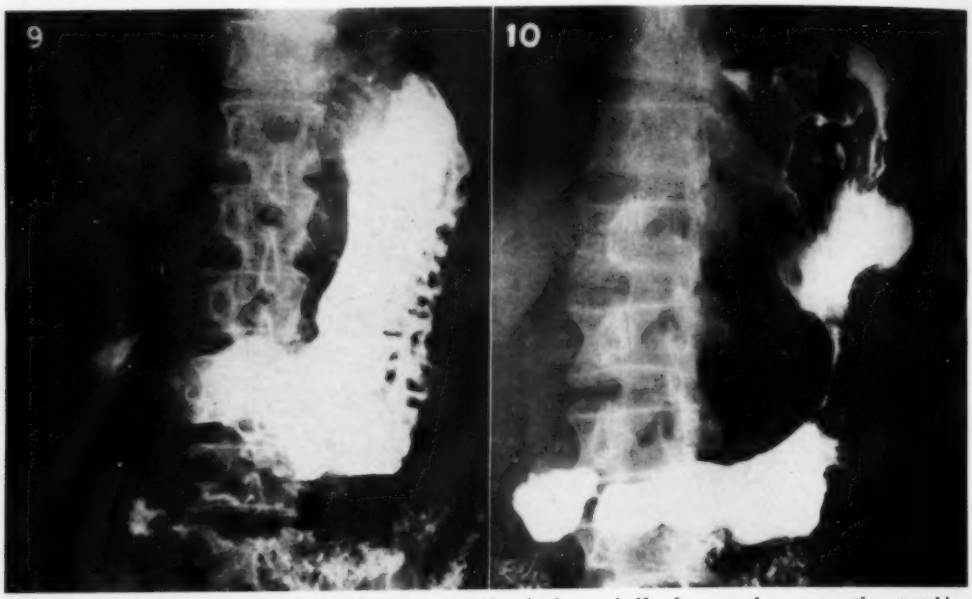

Fig. 9. Case VII. Massive mucosal fold destruction in lower half of stomach, apparently stretching base of duodenal cap.
Fig. 10. Case VIII. Two large pseudo-polypoid lesions with relatively normal intervening gastric wall.

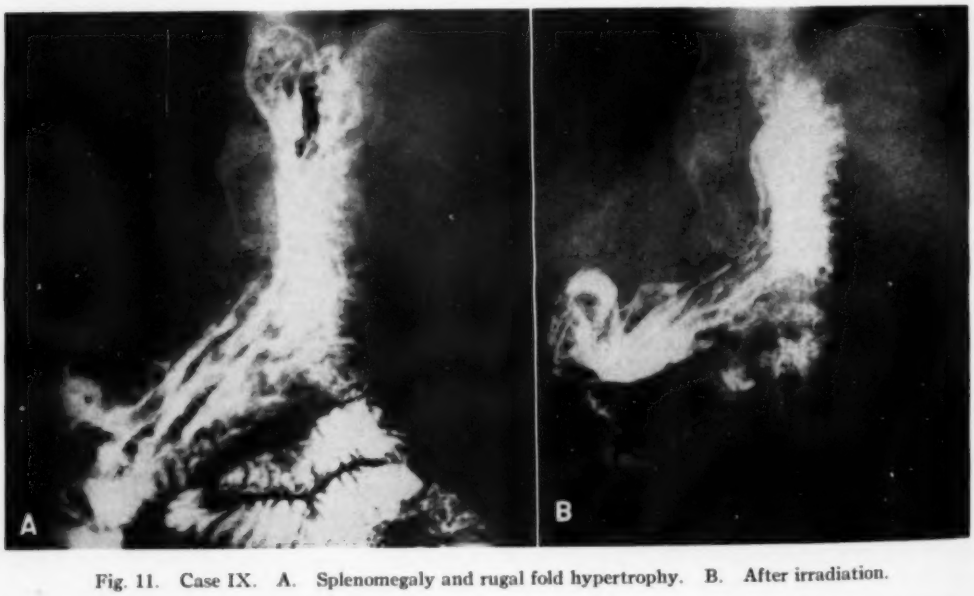

Fig. 11. Case IX. A. Splenomegaly and rugal fold hypertrophy. B. After irradiation.

siderable decrease in the size of the new growths in the mid portion of the stomach.

On July 15, 1944, further roentgen examination was undertaken, but complete obstruction at the pylorus made visualization of new growth in this area and mid-portion of the stomach impossible.

Gastroscopy was reported as showing a benign polyp in the fundus of the stomach just below the cardiac orifice; other polyps were not seen. At operation the left lobe of the liver, lesser curvature of the stomach, and the spleen were found to be involved in a large friable tumor mass. There were

multiple nodules in the gastrocolic and greater omentum. *Pathological report:* Lymphosarcoma.

After supportive therapy and transfusions, the condition remained relatively unchanged. The patient was discharged Feb. 15, 1944, to receive x-ray therapy as an out-patient. Death occurred in August 1944. No autopsy.

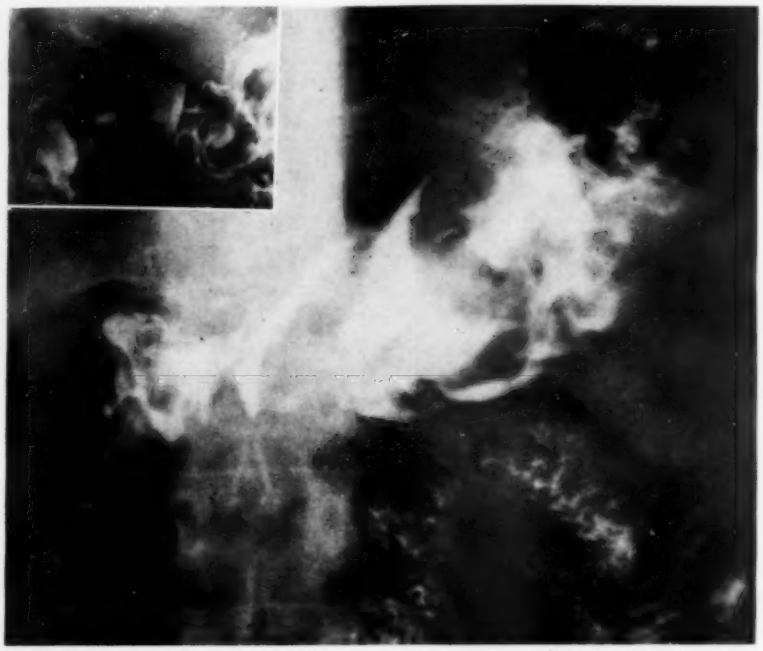

Fig. 12. Prominent gastric folds associated with duodenal ulcer (insert).

CASE IX: A white male laborer was first admitted June 11, 1948, at the age of 66 for contemplated herniorrhaphy. He had no complaints referable to the gastrointestinal tract. In the left upper abdominal quadrant was a mass the size of a grapefruit. Inguinal, axillary, and epitrochlear nodes were present. The red blood count was 3,700,000; hemoglobin 9.9 gm.; white blood count 22,000. A complete study of the blood and bone marrow led to a diagnosis of acute myelogenous leukemia, probably monocytic leukemia of Nägeli type.

The patient was discharged to the Out-patient Department on July 8, 1948. Subsequent examination showed petechiae of the buccal mucosa, a large mass in the left upper quadrant, which appeared to be spleen, and inguinal, axillary, and epitrochlear nodes. The red blood count was 3,250,000; hemoglobin 10.4 gm., white blood count 48,350. A complete study of blood and bone marrow led to a diagnosis of lymphatic leukemia with lymphoblastic infiltration of bone marrow.

Roentgen study of the stomach on March 28, 1949 (Fig. 11A), showed gastric displacement to the right by a tremendously enlarged spleen, which reached the iliac crest. Huge rugal folds were noted throughout the stomach, but the rugal hypertrophy was most marked in the body and pyloric antrum. The gastric wall was not completely fixed, although there was some interference with peristalsis. Hypertrophy of the folds was noted also in the base of the duodenal cap. In the pyloric antrum was a suspicious area of superficial ulceration. A trace of barium remained in the stomach after four hours. The roentgen interpretation was: "Known leukemia; gastric wall infiltration due to leukemia; gastric displacement secondary to splenomegaly."

Further roentgen study, May 27, 1949 (Fig. 11B), following nitrogen mustard and roentgen therapy to the upper abdomen, was reported as showing splenic enlargement as previously noted and leukemic infiltration of the gastric wall with considerable response to therapy. *Pathologic report on biopsy of lymph nodes:* Lymphatic leukemia.

The patient was followed for one year, during which there were intermittent recurrence and remission of gastrointestinal symptoms. Fractional roentgen therapy was given for palliation. Death occurred in February 1951. No autopsy.

SUMMARY

The pathological, clinical, and roentgen findings of lymphoma of the stomach have

been reviewed, and illustrative cases have been presented. It is thought that, with appreciation of the gross changes commonly encountered, careful examination, and utilization of gastroscopy in all suspicious cases, the preoperative diagnosis of lymphoma of the stomach should be entertained more frequently in the future.

Buffalo General Hospital
100 High St.
Buffalo 3, N. Y.

REFERENCES

1. ANDERSON, W. A. D.: Pathology. St. Louis, C. V. Mosby Co., 2d ed., 1953.
2. BOYD, W. A: Text-book of Pathology. Philadelphia, Lea & Febiger, 3d ed., 1938.
3. BIGGS, A. D., AND ELLIOTT, A. R.: Pseudoleukemia Gastro-Intestinalis. J.A.M.A. **83:** 178–181, July 19, 1924.
4. BUSCHKE, F., AND CANTRIL, S. T.: Secondary Lymphosarcoma of the Stomach. Am. J. Roentgenol. **49:** 450–454, April 1943.
5. CRAVER, L. F., AND HERRMANN, J. B.: Abdominal Lymphogranulomatosis. Am. J. Roentgenol. **55:** 165–172, February 1946.
6. CATSARAS, J., AND PATSOURI, E.: Beitrag zur primären Lymphogranulomatose des Magens. Virchows Arch. f. path. Anat. **307:** 303–306, 1941.
7. COLE, L. G., AND OTHERS: Radiological Exploration of the Mucosa of the Gastro-Intestinal Tract. Milwaukee, Bruce Publishing Co., 1934.
8. COTTET, P.: Rare Non-Cancerous Infiltration of Stomach. Radiol. clin. **16:** 13–23, 1947.
9. EUSTERMAN, G. B.: Gastric Syphilis: Observations Based on 93 Cases. J.A.M.A. **96:** 173–179, Jan. 17, 1931.
10. EWING, J.: Neoplastic Diseases. Philadelphia, W. B. Saunders Co., 4th ed., 1942.
11. GOLDEN, R.: Diagnostic Roentgenology. The Roentgen Ray Examination of the Digestive Tract. New York, Thomas Nelson & Sons, New York, 1948, Vol. I, pp. 304–312.
12. GRANT, J. C. B.: A Method of Anatomy: Descriptive and Deductive. Baltimore, Williams & Wilkins Co., 3d ed., 1944.
13. HOLMES, G. W., DRESSER, R., AND CAMP, J. D.: Lymphoblastoma: Gastric Manifestions with Special Reference to Roentgen Findings. Radiology, **7:** 44–50, July 1926.
14. JUNGMANN, H.: Hodgkin's Disease of the Stomach. Brit. J. Radiol. **16:** 386–387, December 1943.
15. KOCH, C. E.: Leukämische und pseudoleukämische Wandveränderungen des Magens im Reliefbild. Fortschr. a. d. Geb. d. Röntgenstrahlen. **48:** 271–278, September 1933.
16. KOENIG, E. C., AND CULVER, G. J.: Hodgkin's Disease Involving the Stomach. Report of Two Cases. Am. J. Roentgenol. **46:** 827–831, December 1941.
17. MARTIN, W. C.: Lymphoblastoma of the Gastro-Intestinal Tract. Am. J. Roentgenol. **36:** 881–891, December 1936.
18. MAXIMOW, A. A., AND BLOOM, W. A.: Textbook of Histology. Philadelphia, W. B. Saunders Co., 2d ed., 1937.
19. RENSHAW, J. F.: Lymphoblastoma of the Stomach. Report of a Case with Especial Reference to Gastroscopic Appearance. J.A.M.A. **107:** 426–428, Aug. 8, 1936.
20. RICKETTS, W. E., KIRSNER, J. B., AND PALMER, W. L.: Large, Otherwise Normal Gastric Rugae, Simulating Tumor of the Stomach: Report of 3 Cases. Gastroenterology **8:** 128–130, February 1947.
21. RIGLER, L. G.: Leukemia of the Stomach Producing Hypertrophy of Gastric Mucosa. J.A.M.A. **107:** 2025–2028, Dec. 19, 1936.
22. RUGGLES, H. E., AND STONE, R. S.: Lymphoblastoma Involving the Stomach, Roentgenologically Considered. California & West. Med. **33:** 486–490, July 1930.
23. SCHINDLER, R.: Gastroscopy. The Endoscopic Study of Gastric Pathology. Chicago, Univ. Chicago Press, 1937.
24. SCHINZ, H. R., BAENSCH, W. E., AND FRIEDL, E.: Lehrbuch der Röntgendiagnostik. Leipzig, Georg Thieme, 3d ed., 1932.
25. SCHLAGENHAUFER: Granulomatosis of the Gastro-Intestinal Tract. Zentralbl. f. path. Anat. **24:** 965–966, 1913.
26. SINGER, H. A.: Primary Isolated Lymphogranulomatosis of the Stomach. Arch. Surg. **22:** 1001–1017, June 1931.
27. TAYLOR, E. S.: Primary Lymphosarcoma of Stomach. Ann. Surg. **110:** 200–221, August 1939.
28. TEMPLETON, F. E.: X-Ray Examination of the Stomach. Chicago, Univ. Chicago Press, 1944.
29. WALLHAUSER, A.: Hodgkin's Disease. Arch. Path. **16:** 522, October, and 672, November 1933.

SUMARIO

Linfoma Gástrico

El término de linfoma abarca todas las enfermedades inevitablemente letales de los tejidos linfoideos. De las lesiones malignas del estómago, menos de 2 por ciento corresponden a esta clasificación, comprendiendo el linfoma folicular gigante, la enfermedad de Hodgkin, el linfosarcoma y la leucemia. De éstos, el más común es la enfermedad de Hodgkin.

En el linfoma, los hallazgos clínicos no son típicos. En general, el estado nutritivo del enfermo es bueno, en contraposición a la caquexia y al debilitamiento del carcinoma. Reconócense cinco formas roentgenológicas, que pueden presentarse ya solas o combinadas: (1) nódulos submucosos múltiples con interposición de pared gástrica normal; (2) espesamiento localizado parecido a placas en la pared gástrica; (3) lesiones seudopolipoideas en

vías de eversión que afectan total o parcialmente el estómago; (4) ulceración; (5) forma rugosa gigante difusa. Puede haber peristaltismo, aunque perezoso, a pesar de la invasión masiva. La gastroscopia es de valor, pero quizás se necesite una biopsia para el diagnóstico.

Preséntanse 9 casos. Dedúcese que, con la apreciación de las alteraciones macroscópicas observadas comúnmente, el examen cuidadoso y la utilización de la gastroscopia en todos los casos sospechosos, debe considerarse más frecuentemente el diagnóstico de linfoma del estómago.

Insulin-Induced Hypermotility in the Roentgen Examination of the Stomach and Duodenum[1]

DENIS C. ADLER, M.D., GEORGE JACOBSON, M.D., KENNETH A. HEITMANN, M.D., and DERRELL D. WATSON, M.D.

ADEQUATE EFFECTIVE peristalsis is essential for the successful radiologic examination of the upper gastrointestinal tract. The possibility of using various pharmacologic agents to induce peristalsis, particularly in the stomach and duodenum, is not a new idea and may be traced back at least to 1914, when Pancoast (14) observed an hourglass constriction of the stomach and hypomotility of the small intestine in a patient several hours following the administration of morphine. A year later, he and Hopkins (15) reported on the effects of morphine and heroin on the motility of the gastrointestinal tract. They studied both animals and human beings by means of fluoroscopy and roentgenograms, and concluded that these drugs caused hyperperistalsis and delayed emptying of the stomach. "The most surprising result of our observation," they wrote, "has been the lack of any degree of uniformity in the effects produced in different individuals."

Most of the reports dealing with the pharmacoradiologic use of morphine have appeared in the European literature. No attempt will be made to review all of them. Porcher (17) in 1943 reported on the use of morphine for the demonstration of duodenal ulcer. He stated that the subcutaneous injection of the drug produced: increased tonus of the gastric musculature, hypermotility of the stomach with active peristalsis, and dilatation of the duodenum. In a subsequent study in 1949 (18), based on 6,000 examinations, Porcher and his co-workers found that 80 per cent of their patients showed all three of these changes. They employed morphine primarily for investigation of the duodenal bulb. In only 8 per cent of their cases were there side-effects, namely, nausea, vomiting, and fainting. No contraindications to use of the drug was found even in children and aged individuals.

In 1945, Albot, Sicard, and Marquis (7) reported a case in which a small infiltrating carcinoma of the lesser curvature of the stomach was detected as a result of the hypermotility caused by injection of morphine. Again, in 1946, Albot and his coworkers (6) presented a similar case in which the carcinoma measured 1 cm. in diameter and was limited to the mucosa. In this and subsequent papers (2–6) they stated that morphine produces: (*a*) hypermotility, which contrasts a small area of stiffness with the surrounding flexible stomach wall; (*b*) gastric hypertension, which is responsible for sharp delineation of the area of induration; and (*c*) increased tonus of the muscularis mucosae, which accentuates large stiff folds converging toward the center of the lesion. They contended (4) that by these characteristics benign lesions could be distinguished from small carcinomas.

There have been many other reports dealing with the use of morphine, all coming to substantially the same conclusions. In one of the most recent studies on the subject Stössel (25) employed morphine both subcutaneously (0.01 gm.) and intravenously (0.005 gm.) in some 10,000 examinations, with what he considered excellent results.

[1] From the Departments of Radiology of the College of Medical Evangelists (D.C.A.) and University of Southern California (G.J. and K.A.H.), and the Department of Medicine, University of Southern California (D.D.W.), and the Los Angeles County Hospital.

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Ritvo (22, 23) investigated the use of physostigmine rather extensively and stated that he "found it to be of great value in overcoming atonicity and sluggishness of peristalsis." In doses of 2.6 mg. by mouth or 1.3 mg. subcutaneously, it increased peristalsis in 85 per cent of his cases. He found that mecholyl produced even more vigorous peristalsis, but severe side-reactions were frequent and he advised against its use.

Rasmussen (21) found that, while morphine produced the desired increase in gastric tonus and peristalsis in almost 100 per cent of his cases, it often gave rise to unpleasant side-effects. On the other hand, physostigmine, (0.5 mg. subcutaneously), which caused no serious side-effects, was effective in only two-thirds of his cases. He used morphine plus prostigmine intramuscularly, but this combination produced untoward side-reactions. He also tried prostigmine and atropine in an attempt to induce hyperperistalsis while relieving pylorospasm, but this was not altogether successful.

In this search for an ideal pharmacoradiologic agent, even ipecac has been investigated (1, 16). Albot (1) gave 40 gm. of ipecac syrup the day before or on the morning of an examination. Marked hypermotility, lasting for several hours, was often noted. The individual response was quite variable, however, and the use of the drug was frequently accompanied by severe vomiting.

Ever since Bulatao and Carlson (9) reported in 1924 that insulin-induced hypoglycemia produced hypermotility of the fasting stomachs of dogs, this phenomenon has been the subject of extensive investigation. The response has been observed more consistently and to a greater degree in dogs than in human subjects (19). In fact, some workers (11, 13) have failed to confirm its occurrence in man. However, most investigators have come to believe that insulin hypoglycemia does produce gastric hypermotility in the human. In an exhaustive review of the subject, Bachrach (8) concluded that "the existing evidence indicates that in dog and man hypoglycemia augments those functions which are under the influences of the vagus nerve by stimulating vagal centers somewhere in the brain." Injection of insulin after vagotomy was observed by Quigley and Templeton (20) and Lalich, Youmans, and Meek (12) to result in an inhibition of gastric motility. This failure of insulin to stimulate gastric motility after vagotomy has been employed as a test for the presence of intact nerve fibers (10, 24).

Pursuing their pharmacoradiologic investigations, Albot, Perier, and Olivier (6) in 1946 used the effect of insulin on gastric motility to diagnose a small infiltrating prepyloric carcinoma. In 1952, reviewing the various agents employed by his group, Albot (1) came to the conclusion that 10 to 20 units of insulin, given intravenously, would produce an effective increase in gastric peristalsis, rapid emptying of the stomach, and dilatation of the duodenal bulb. He found that, while morphine produced more violent peristalsis, it was not as reliable as insulin. Approximately 8 to 10 per cent of his patients failed to respond to morphine, while insulin was effective in almost every instance, though there was some variation in the degree of response. He therefore employed intravenous insulin regularly, reserving the use of morphine for those occasions when he wished to produce violent peristalsis.

The foregoing reports stimulated us to attempt an evaluation of these pharmacoradiologic methods. We hoped to develop a simple clinical procedure by which peristalsis could be controlled. If we were successful, the benefits to be derived from such a technic were obvious.

PRELIMINARY STUDIES OF NORMAL INDIVIDUALS

Five normal individuals (medical students) were studied. Each was examined on three separate occasions, several days to a week apart. First, a conventional upper gastrointestinal examination was performed. The other two examinations differed only in that one was performed 5

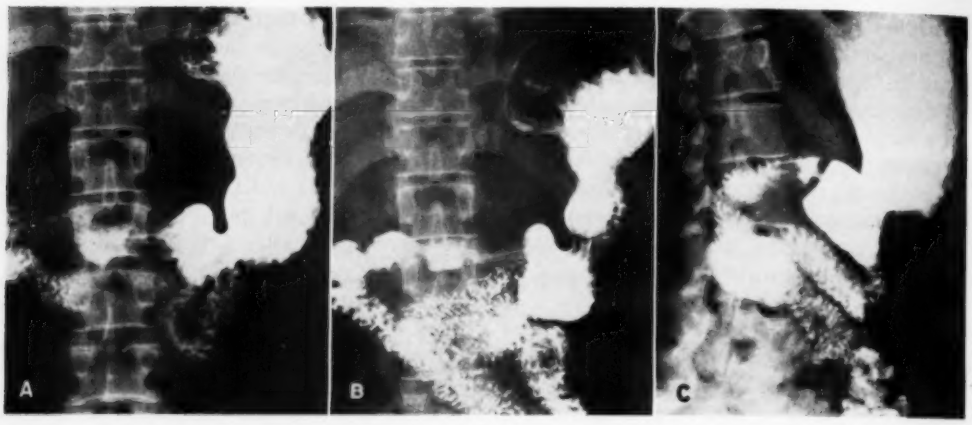


Fig. 1. A. Conventional upper gastrointestinal examination with barium-filled stomach showing moderate peristaltic activity.
B. Marked peristaltic activity following the intravenous injection of insulin (0.2 units per kg. body weight).
C. Moderate peristaltic activity following the intravenous injection of 1/6 gr. morphine. Note the dilatation of the fundus of the stomach, increased secretion, flocculation of barium, and slight segmentation of duodenum.

to 10 minutes after the intravenous injection of 1/6 grain of morphine and the other five to ten minutes after the intravenous injection of 10 to 20 units of crystalline insulin (0.2 units per kilogram of body weight).

It was our impression that both insulin and morphine increased gastric peristalsis. However, in addition, morphine produced delayed gastric emptying and an abnormal appearance of the stomach and duodenum (Fig. 1). In view of these findings and the most recent report of Albot, stressing the superiority of insulin, it was decided to begin our clinical investigations with that drug.

CLINICAL STUDIES WITH INSULIN

Our clinical material consisted of 56 patients who had had one or more conventional upper gastrointestinal examinations in which the findings were inconclusive. These cases were divided into the following groups: (I) deformity of the antrum, (II) possible gastric ulcer, (III) possible duodenal ulcer, (IV) deformities of the bulb and/or second portion of the duodenum, (V) possible lesions of the upper third of the stomach, and (VI) frank gastric neoplasms.

Although every attempt was made to have the insulin examination follow the conventional examination promptly, this was not always feasible. Most of the patients were re-examined in two to fourteen days. Occasionally the insulin examination was delayed twenty to twenty-five days, and in one instance forty-two days.

Crystalline insulin was given intravenously, and in most cases in the dosage of 0.2 units per kilogram of body weight. In debilitated and elderly patients, the dose was reduced to 0.1 units per kilogram. In some instances even smaller amounts were given. The roentgen examination was usually begun five minutes after the insulin was administered and was completed in about fifteen minutes.

The majority of the patients had symptoms of mild hypoglycemia. Several had severe reactions. All responded to orange juice, and in no instance was intravenous glucose necessary.

PERISTALTIC ACTIVITY

It was the impression of the fluoroscopist that hyperperistalsis occurred in most cases. This was first observed two to five minutes after the injection of insulin and lasted for a variable period of time. The peristaltic waves began just below the upper third of the stomach and increased in amplitude as they approached the py-

lorus. It appeared that the duodenal bulb and duodenum were more distended and remained filled longer than usual. Considerable individual variation was encountered both as to intensity and duration of the peristaltic activity. In some individuals there were alternating periods of hypermotility and hypomotility. There was no correlation with the dosage of insulin.

EVALUATION OF INSULIN EXAMINATIONS

The cases were arbitrarily classified 0, +, and ++, depending on the additional information derived from the insulin re-examinations (Table I): ++, demonstration of a previously non-visualized or poorly visualized lesion and/or exclusion of a lesion permitting a more definite diagnostic conclusion; + improved visualization of a lesion without the addition of diagnostic information; 0, no improvement in visualization of lesion and no information derived from the re-examination.

Group I. Deformity of the Antrum: In 13 cases the conventional examination showed some deformity of the antrum of the stomach. In this group the insulin examination was of definite value (++) in 7, of questionable value (+) in 4, and of no value (0) in 2. Three of the 7 patients in whom the insulin examination was considered to be of value were shown radiologically to have duodenal ulcers. In each, the antrum of the stomach was normal. In 3 cases an irregularity of the antrum disappeared on re-examination. In the seventh case, the insulin examination showed that, though an antral irregularity was

TABLE I: ADDITIONAL INFORMATION DERIVED FROM INSULIN RE-EXAMINATION

	Definite Value ++	Questionable Value +	No Value 0	Total
Group I: Deformity of the Antrum	7	4	2	13
Group II: Gastric Ulcer	6	2	2	10
Group III: Duodenal Ulcer	6	7	4	17
Group IV: Deformities of the Bulb and/or Second Portion of Duodenum	4	0	5	9
Group V: Gastric Neoplasm	0	1	2	3
Group VI: Upper Third of Stomach	1	0	3	4
TOTAL	24	14	18	56

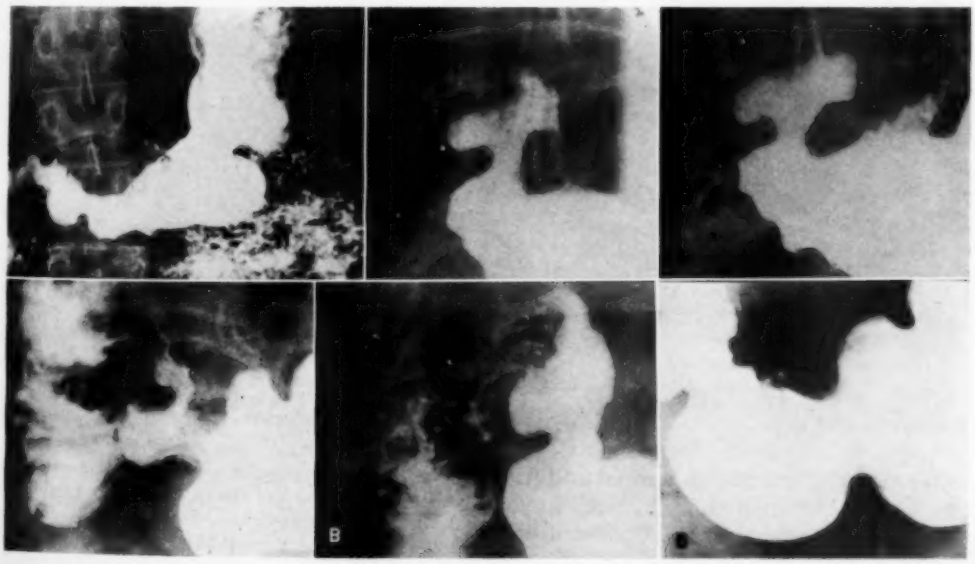


Fig. 2. A. Conventional examination. Constant deformity of the antrum, which is slightly irregular, contracted, and stiff; abnormal mucosa. Duodenal bulb not well visualized. Interpreted as infiltrating carcinoma. B. Insulin examination six days later. Normal antrum. Deformed duodenal bulb.

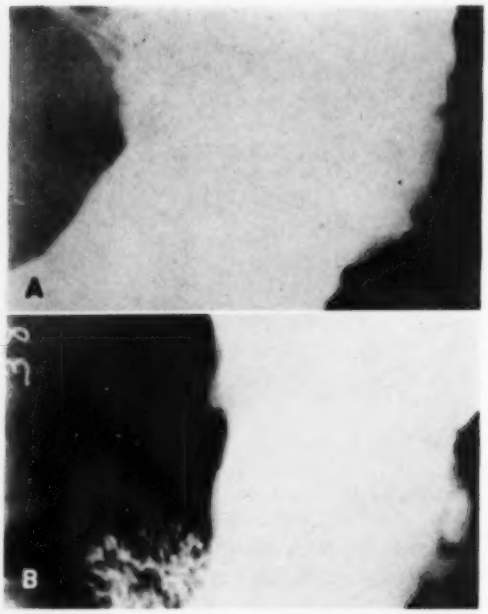


Fig. 3. A. Conventional examination. Slight stiffness and irregularity with questionable ulceration of the lesser curvature of the stomach.
B. Insulin examination twelve days later. Gastric ulcer with surrounding wall smooth and pliable. Benign peptic ulcer confirmed at operation.

which was interpreted as showing an infiltrating carcinoma of the lesser curvature of the antrum. The duodenal bulb was not well visualized. Six days later she was re-examined following the intravenous injection of 10 units of insulin (0.2 per kg.). The antrum was normal but the duodenal bulb was definitely deformed. The insulin examination was repeated after another week with identical results. Gastroscopy confirmed the presence of a normal antrum.

Group II. Gastric Ulcer: There were 10 patients with gastric ulcers. The insulin examination was considered to be of definite value (++) in 6 of these, of questionable value (+) in 2, and of no value (0) in 2. In 3 cases a gastric ulcer was first demonstrated by the insulin. In 3 others the ulcer and the mucosal folds around it were so well visualized that a probable benign peptic ulcer could be suggested. Two of these 3 ulcers were proved benign at operation and the third was followed medically.

CASE 2 (Fig. 3): In a 53-year-old male a conventional upper gastrointestinal examination showed stiffness of the lesser curvature of the middle third of the stomach. This stiff area was slightly irregular, with a questionable ulceration. Twelve days

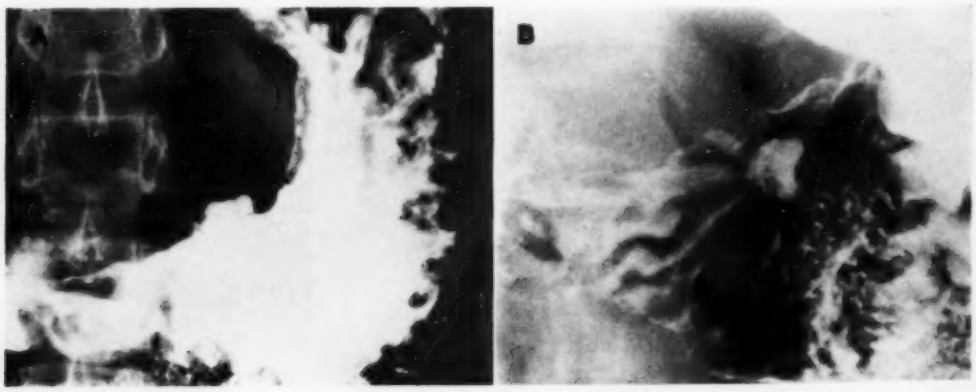


Fig. 4. A. Conventional examination. Irregular ulcer crater of the lesser curvature of the stomach.
B. Insulin examination eight days later. *En face* ulcer with radiating mucosal folds. Benign peptic ulcer confirmed at operation.

still present, it was not as marked as during the conventional study. In addition, a persistent deformity of the duodenal bulb was demonstrated.

CASE 1 (Fig. 2): A 50-year-old woman had had a conventional upper gastrointestinal examination later 15 units of insulin were given intravenously (0.2 units per kg.) and the patient was re-examined. A 1.5-cm. ulcer was clearly visualized and there was no stiffness of the surrounding gastric wall. Radiologically this was considered to be a benign peptic ulcer. This opinion was subsequently confirmed at operation.

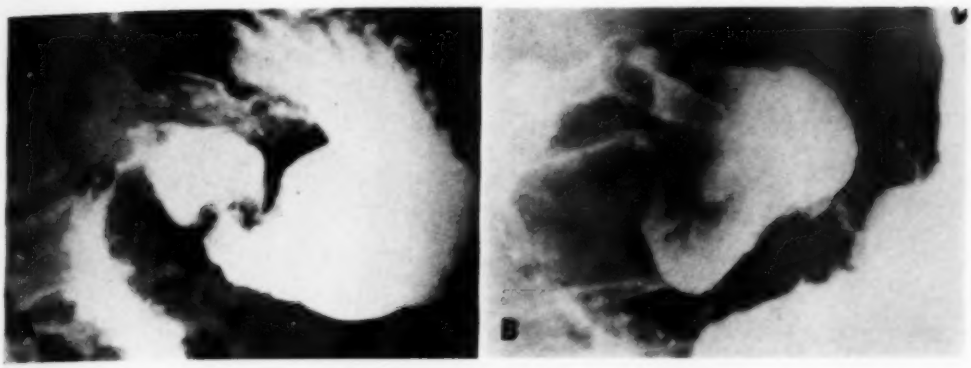


Fig. 5. A. Conventional examination, showing questionable irregularity of duodenal bulb. B. Insulin examination thirteen days later. Ulcer crater in large atonic duodenal bulb.

CASE 3 (Fig. 4): In a 52-year-old male the routine upper gastrointestinal examination showed an irregular ulcer crater at the incisura of the stomach and a deformed duodenal bulb. Eight days later he was given 8 units of insulin intravenously (0.1 unit per kg.) and re-examined. An *en face* 1.5-cm. ulcer with radiating mucosal folds was seen at the incisura and was considered benign. This was confirmed at operation.

Group III. Duodenal Ulcer: Seventeen patients had duodenal ulcers. In these cases the insulin examination was of definite value (++) in 6, of questionable value (+) in 7, and of no value (0) in 4. In 5 of the 6 cases in which insulin was believed to be of definite value, a persistently deformed bulb or ulcer crater was demonstrated for the first time. In the sixth case, radiating folds but no ulcer crater were clearly visualized in a duodenal bulb which was questionably irregular on pre-insulin examination.

CASE 4 (Fig. 5): A 54-year-old male was shown to have a questionably irregular duodenal bulb on a conventional upper gastrointestinal examination. Thirteen days later he was re-examined after the intravenous injection of 6 units of insulin (0.1 unit per kg.). A 6-mm. *en face* ulcer was seen in a large atonic duodenal bulb.

Group IV. Deformities of the Bulb and/or Second Portion of the Duodenum: There were 9 patients who had, on conventional upper gastrointestinal examination, a slight irregularity of the apex of the bulb or second portion of the duodenum. The insulin examination was of definite value (++) in 4 of the number and was of no value (0) in 5. In 3 of the 4 cases in which insulin was thought to be of definite value, questionable lesions of the apex of the duodenal bulb were excluded. In the other case, a duodenal diverticulum which had not been seen on the first examination was demonstrated.

CASE 5 (Fig. 6): A 60-year-old female had had a conventional upper gastrointestinal examination which was interpreted as showing an extrinsic pressure defect on the medial aspect of the second portion of the duodenum. Forty-two days later she was re-examined after receiving 7 units of insulin (0.1 unit per kg.) intravenously. There was no evidence of an extrinsic pressure defect. A diverticulum, which probably had caused the previous deformity, was visualized, arising in the medial wall of the duodenum in the region of the ampulla.

Group V. Gastric Neoplasm: Three patients in the series had gastric neoplasms, 2 infiltrating ulcerating carcinomas and 1 Hodgkin's disease. The insulin examination was of definite value (++) in none of these, of questionable value (+) in 1, and of no value in 2. As a matter of interest, the 2 carcinomas were not as well demonstrated on the insulin examination as they were on the conventional studies.

Group VI. Lesions of the Upper Third of the Stomach: Among 4 patients with deformities of the upper third of the stomach the insulin examination was of definite value in 1 and of no value in 3. In the case in which it was considered to be of value, the insulin examination rather conclusively demonstrated a normal stomach.

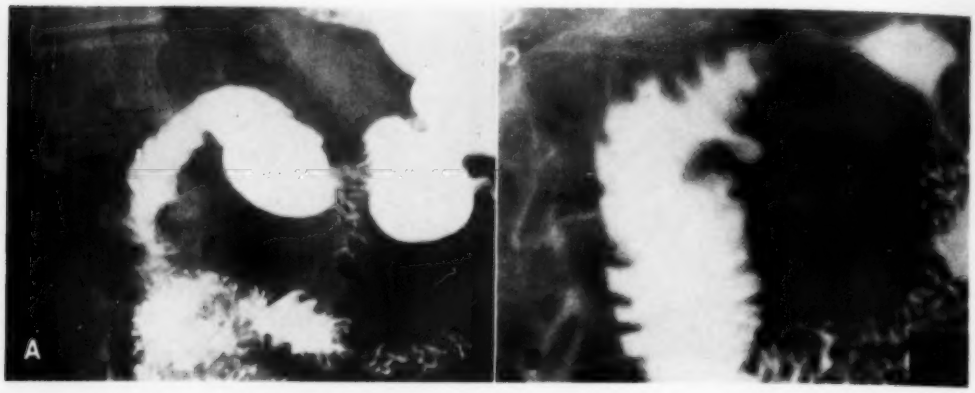


Fig. 6. A. Conventional examination. Extrinsic pressure defect on medial aspect of descending duodenum. B. Insulin examination forty-two days later. Duodenal diverticulum arising in the region of the ampulla of Vater. No evidence of a filling defect.

whereas the conventional study had suggested an ulcer high on the lesser curvature.

DISCUSSION

The enthusiastic reports concerning pharmacoradiologic examinations of the upper gastrointestinal tract would lead one to expect that considerable added information could be readily gained by such methods. In selected patients of our series, the results of the insulin re-examination were impressive. It is apparent, however, from Table I that the procedure was of definite value in slightly less than one-half of the cases. In one-fourth of the cases it was of questionable value, and in the remainder it was of no value.

In considering the results of insulin re-examination, many factors have to be evaluated:

1. Following an inconclusive routine upper gastrointestinal examination, re-examination usually yields additional information and is of considerable value. A series of cases comparable to ours, re-examined without the use of insulin, might be expected to give similar results. It is difficult to determine, therefore, how much added diagnostic information was attributable to the re-examination itself and how much to hypermotility that may have been induced by insulin.

2. The attention of the radiologist during the re-examination was focused on a specific area and problem.

3. The routine examination preceded the insulin examination by varying periods during which the patient received treatment.

4. Psychogenic factors involving the patient, such as training, familiarity with the procedure and surroundings, relaxation, etc., were undoubtedly of considerable importance.

We have also encountered great difficulty in evaluating the hyperperistalsis induced by insulin. Many have stated unequivocally that hyperperistalsis follows intravenous injection of insulin. The same subjective impression was gained during fluoroscopic observation of most of our patients, though the response was more variable than that reported by others. However, improved gastric peristalsis frequently occurs during any re-examination of the upper gastrointestinal tract. The radiographs of the barium-filled stomach and spot films made during fluoroscopy after the injection of insulin were compared with those made during the conventional study. There was no convincing proof of significant gastric hyperperistalsis.

The above considerations, plus the fact that we have not been able to confirm conclusively the particular value of the insulin re-examination, have led us to doubt the actual occurrence of significant insulin-

induced hypermotility in the barium-filled stomach. Controlled radiologic studies with simultaneous balloon kymography in normal individuals are being undertaken in an attempt to answer this question. We are also continuing to investigate the use of other drugs as a means of producing gastric hyperperistalsis.

SUMMARY

An investigation is reported of the intravenous injection of insulin as a means of producing hyperperistalsis during the radiologic examination of the upper gastrointestinal tract. Insulin examinations were performed in 56 patients who had previously had conventional examinations with inconclusive findings. It is doubtful that the information gained from the insulin studies was more than might be expected from any other re-examination.

The variability of the response to insulin leads us to question the occurrence of significant insulin-induced hypermotility in the barium-filled stomach.

George Jacobson, M.D.
1200 N. State St.
Los Angeles 33, Calif.

REFERENCES

1. ALBOT, G.: Pharmaco-radiography of the Stomach and Duodenum. Am. J. Digest. Dis. **19:** 82–89, March 1952.

2. ALBOT, G., GARCIA CALDERON, G., AND MARQUIS, G.: Les methodes pharmacodynamiques associées à la compression dans le diagnostic radiologique du cancer de l'estomac au début. Arch. d. mal. de l'app. digestif. **36:** 277–282, May–June 1947.

3. ALBOT, G., LE CANUET, R., AND POUEY, A.: Accentuation des anomalies du profil et du relief muqueux de l'estomac par hypertonie de la musculaire-muqueuse au cours de la pharmacoradiographie morphinique (a propos d'un épithelioma purement muqueux in situ). Arch d. mal. de l'app. digestif. **35:** 189–200, June–July 1946.

4. ALBOT, G., LEGERON, G., AND TRICARD, A.: L'étude du relief muqueux périlésionnel par l'association de la pharmaco-radiographie et de la compression dosée; ses caractères dans les lésions benignes et son utilité dans le diagnostic avec cancer de l'estomac au début. Semaine Hôp. Paris **26:** 3599–3602, Sept. 14, 1950.

5. ALBOT, G., AND MARQUIS, G.: Étude du relief muqueux périlésionnel dans le cancer de l'estomac au début, par l'association de la pharmacoradiographie et de la compression dosée (à propos de 6 observations). Semaine Hôp. Paris **24:** 283–296, Feb. 6, 1948.

6. ALBOT, G., PERIER, E. A., AND OLIVIER, C.: Pharmacoradiographie insulinique et cancer de l'antreprepylorique. Arch. d. mal. de l'app. digestif. **35:** 224–226, June–July 1946.

7. ALBOT, G., SICARD, A., AND MARQUIS, G.: Pharmacoradiographie morphinique et compression dosée associées dans le diagnostic d'un cancer muqueux "in situ" de la petite courbure horizontale de l'estomac. Presse méd. **53:** 350–351, June 30, 1945.

8. BACHRACH, W. H.: Action of Insulin Hypoglycemia on Motor and Secretory Functions of the Digestive Tract. Physiol. Rev. **33:** 566–592, October 1953.

9. BULATAO, E., AND CARLSON, A. J.: Contributions to Physiology of the Stomach; Influence of Experimental Changes in Blood Sugar Level on Gastric Hunger Contractions. Am. J. Physiol. **69:** 107–115, June 1924.

10. FELDMAN, M., AND MORRISON, S.: The Effect of Insulin on Motility of the Stomach Following Bilateral Vagotomy. Am. J. Dig. Dis. **15:** 175, June 1948.

11. HEINZ, T. E., AND PALMER, W. L.: A Study of the Effect of Insulin on Gastric Motility. Proc. Soc. Exper. Biol. & Med. **27:** 1047–1049, June 1930.

12. LALICH, J., YOUMANS, W. B., AND MEEK, W. J.: Insulin and Gastric Motility. Am. J. Physiol. **120:** 554–558, Nov. 1, 1937.

13 MAHLER, P.: Der Tonus des menschlichen Magens und Darms im Insulinshock. Ztschr. f. d. ges. exper. Med. **73:** 817–821, 1930.

14. PANCOAST, H. K.: Possible Effect of Morphine on Intestinal Motility. Am. J. Roentgenol. **2:** 549–551, December 1914.

15. PANCOAST, H. K., AND HOPKINS, A. H.: Effect of Moderate Doses of Some Opium Derivatives on the Gastrointestinal Tract of Man. Preliminary Report on Roentgen Studies. J.A.M.A. **65:** 2220–2224, Dec. 25, 1915.

16. PIZON, P.: Pharmacoradiographie oesophagogastro-duodénale. Presse méd. **61:** 407–408, March 21, 1953.

17. PORCHER, P.: La stase duodenale provoquée, procédé simple, rapide, fidèle d'ameliorer la visiblité radiologique et les details de l'image du bulbe ulcereux. Arch. d. mal. de l'app. digestif. **33:** 24–26, January–Febuary 1944.

18. PORCHER, P., BOURDON, R., BOUDAGHAN, B., AND SAUVEGRAIN, G.: Bilan de la morphine après 6,000 examens. Arch. d. mal. de l'app. digestif. **38:** 942–944, September–October 1949.

19. QUIGLEY, J. P., JOHNSON, V., AND SOLOMON, E. I.: Action of Insulin on the Motility of the Gastrointestinal Tract. I. Action on the Stomach of Normal Fasting Man. Am. J. Physiol. **90:** 89–98, September 1929.

20. QUIGLEY, J. P., AND TEMPLETON, R. D.: Action of Insulin on the Motility of the Gastrointestinal Tract. IV. Action on the Stomach Following Double Vagotomy. Am. J. Physiol. **91:** 482–487, January 1920.

21. RASMUSSEN, T.: Pharmacoradiography of the Stomach. Nord. med. **44:** 1563–1566, Sept. 29, 1950.

22. RITVO, M.: Drugs as an Aid in Roentgen Examination of the Gastrointestinal Tract. The Use of Mecholyl, Physostigmine, and Benzedrine in Overcoming Atonicity, Sluggishness of Peristalsis, and Spasm. Am. J. Roentgenol. **36:** 868–874, December 1936.

23. RITVO, M., AND WEISS, S.: Physostigmine as an Aid in Gastrointestinal Roentgen-Ray Diagnosis. Am. J. Roentgenol. **18:** 301–314, October 1927.

24. STEIN, I. F., JR., AND MEYER, K. A.: Studies on Vagotomy in Treatment of Peptic Ulcer; Use of Insulin In Testing for Completeness of Vagotomy. Surg. Gynec. & Obst. **86:** 473–479, April 1948.

25. STÖSSEL, H. U.: Die klinische Bedeutung der Pharmakoradiographie, insbesondere des Morphiums, bei Erkrankungen des Magens und des Duodenums. Schweiz. med. Wchnschr. **83:** 657–660, July 11, 1953.

SUMARIO

Hipermovilidad Inducida por la Insulina en el Examen Roentgenológico del Estómago y del Duodeno

Descríbese una investigación de la inyección intravenosa de insulina como medio de producir hiperperistaltismo durante el examen radiológico de la porción superior del tubo gastrointestinal. Cincuenta y seis enfermos que habían sido examinados antes con las técnicas acostumbradas fueron reexaminados después de la inyección de insulina. Los diagnósticos primitivos comprendían deformidad del antro, úlceras gástricas o duodenales, deformidades del capuchón duodenal y/o de la segunda porción del duodeno, neoplasias gástricas y lesiones del tercio superior del estómago.

El roentgenoscopista se hallaba bajo la impresión de que aparecía hiperperistaltismo en la mayor parte de los casos, pero que la respuesta era sumamente variable. En poco menos de la mitad de los casos resultó la insulina de valor diagnóstico bien definido. Fué de valor dudoso aproximadamente en la cuarta parte de la serie y no mostró valor en el resto.

Al justipreciar los resultados de este estudio, dedúcese que es dudoso que la información derivada del uso de la insulina sea mayor que la que sería de esperar de cualquier reexamen. Pónese además en tela de juicio la aparición de importante hipermovilidad inducida por la insulina en el estómago lleno de bario.

The Ileum Following Colectomy[1]

SAMUEL H. MADELL, M.D., AND ROSS GOLDEN, M.D.

THE SURGICAL removal of all or the greater part of the large intestine is done to relieve symptoms resulting from extensive disease of the colon. The ileum may be anastomosed with the sigmoid, the rectum, or the anus, or may be brought out through the skin to form a permanent ileostomy. A number of writers (1, 2, 3, 6, 7, 10, 12, 13) have observed that, as time passes, the intestinal contents discharged from the ileum under these conditions gradually become less fluid. This has been interpreted as evidence of increasing ability of the ileum to absorb water and thus make the stool of more normal consistency.

In several cases, gross dilatation of the ileum was found at a subsequent operation (1, 2, 12). In a recent report Dennis and Karlson (5) state that enlargement of the ileum does not occur proximal to an ileostomy which is functioning properly. Mueller and Fischer (10) demonstrated increase in diameter and the development of large mucosal folds in the ileum of dogs following transplantation after excision of a portion of the colon, although the microscopic appearance of the ileum was not changed.

The purpose of this paper is to present the results of roentgen studies of the ileum at various intervals after one of the above-mentioned surgical procedures.

MATERIAL

Eighteen patients were examined, of whom 10 had an ileostomy, 4 ileosigmoidostomy, 2 ileoproctostomy, 1 ileo-anal anastomosis, and 1 sigmoidocecostomy.

Most of the patients had small-intestine studies following the ingestion of barium preparations; a few had barium enema examinations, and some had both. Non-flocculating barium preparations were used for those patients who were brought in during the past year for this particular investigation. It seemed that the non-flocculating preparations were more satisfactory than barium in saline solution. The barium enema gave satisfactory results as far as showing the size of the ileum and the condition of the stoma was concerned. The enema demonstrated the anastomosis better, in fact, than did ingested barium.

RESULTS OF THE EXAMINATIONS

On the basis of the examinations the patients fell into four groups, as follows. (I) those with no demonstrable abnormality of the ileum; (II) those with dilatation associated with inflammatory disease of the ileum; (III) those with dilatation associated with a constriction or stenosis at or distal to the anastomosis; (IV) 2 cases of dilatation of the ileum without obvious cause.

Group I includes 9 patients: 6 with ileostomy and 1 with ileo-anal anastomosis for ulcerative colitis; 2 with ileoproctostomy, 1 for congenital polyposis and 1 for Hirschsprung's disease. The examinations ranged in time from three to fifteen years subsequent to the operation. None of these patients had demonstrable dilatation of the ileum (Figs. 1 and 2). In 1 patient, however, with ileo-anal anastomosis a localized sacculation developed immediately proximal to the anus, simulating a rectal ampulla (Fig. 3). Five of the patients with ileostomy and 2 with ileoproctostomy were without symptoms at the time of examination. The stools were mostly semiformed but varied in consistency from time to time depending upon dietary and emotional factors. One patient (Unit No. 979118) with ileo-anal anastomosis required Banthine to control diarrhea. One pa-

[1] From the Departments of Radiology of the Presbyterian Hospital and of the College of Physicians and Surgeons, Columbia University, New York, N. Y. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

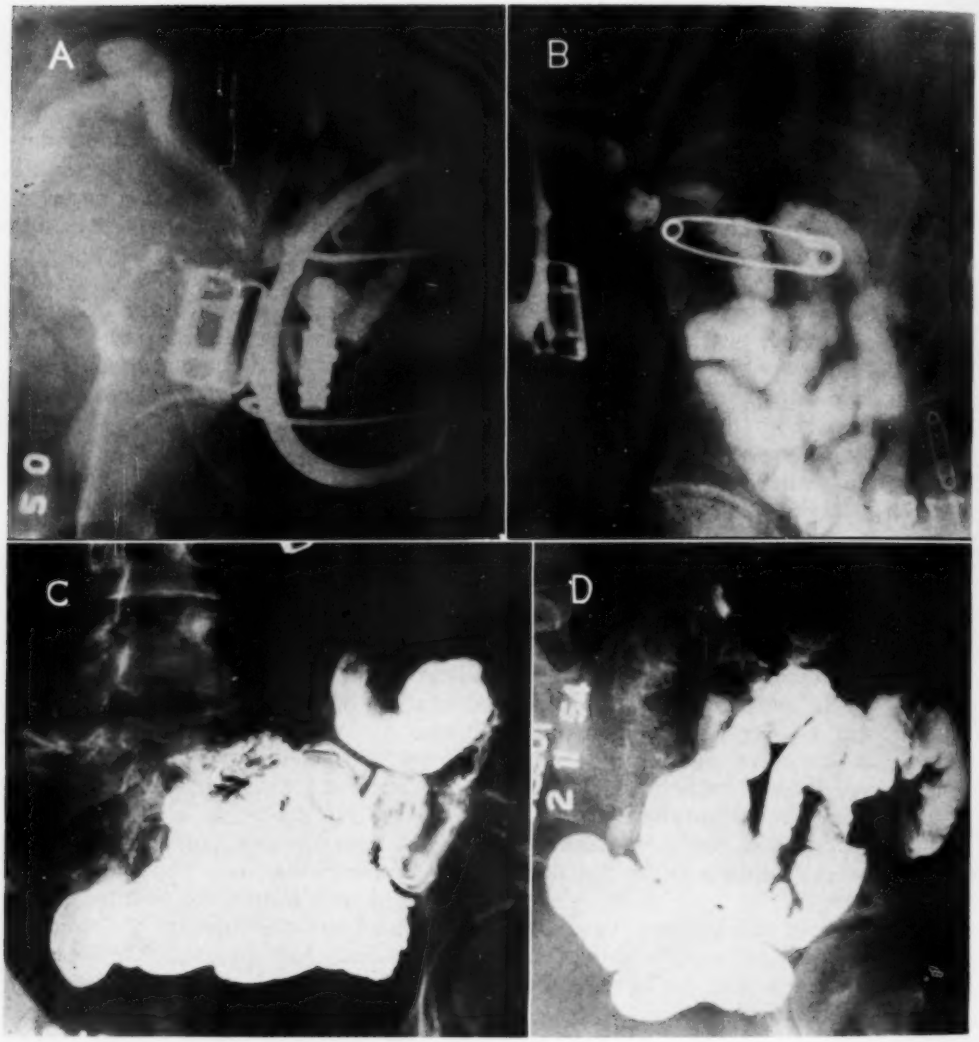


Fig. 1. Normal ileum following colectomy. Films from examinations of 4 patients with ileostomy for ulcerative colitis, showing the distal ileum to be normal in size.
A. Fifteen years after ileostomy at the age of thirty-five. (Unit No. 892895).
B. Three and a half years after ileostomy at the age of forty-two (Unit No. 953492).
C. Three years after ileostomy at the age of nineteen (Unit No. 028034).
D. Eight years after ileostomy at the age of eleven (Unit No. 825812).

tient (Unit No. 776989) discharged an almost continuous liquid stream from her ileostomy for more than two years following the operation, but subsequent to the examination the stools became semiformed.

Group II includes 3 patients, all of whom had ileostomy for chronic idiopathic ulcerative colitis.

A 26-year-old woman (Unit No. 778846) had evidence of ileitis in the terminal 10 cm. of ileum, which was removed with the colon. Immediately following the operation, she began to experience recurrent attacks of abdominal pain, vomiting, and alternating periods of scant and of profuse ileostomy drainage. Roentgen studies revealed evidence of inflammation of the distal ileum and of progressive dilatation with marked ileal stasis (Fig. 4). About two and a half

years after colectomy, she was operated upon because the symptoms seemed consistent with incomplete obstruction. No obstruction was found. The distal 6 feet of the ileum were dilated and showed gross evidence of inflammation of the wall. Large discrete lymph nodes were found in the root of the ileal mesentery, the largest of which measured 2.5 cm. in diameter. The mesentery itself was not thickened.[2]

Fig. 2. Normal ileum three years after ileoproctostomy (Unit No. 054798).

A 15-year-old boy (Unit No. 501318) had evidence of ileitis of the terminal 30 cm. of the ileum, which was removed with the colon. For seven years the stools discharged through the ileostomy were semiformed and the patient was symptom-free. Rhythmically recurring attacks of abdominal cramps and vomiting then developed, associated with scanty watery ileostomy drainage. During these attacks, introduction of a catheter into the stoma caused a discharge of fluid, followed by some relief of symptoms.

Roentgen examination soon after the onset of these recurring attacks revealed no obstruction or other abnormality of the distal ileum. The attacks became more frequent and persistent. Re-examination about one and a half years after the first roentgen study, during an attack, disclosed dilatation of the distal ileum.

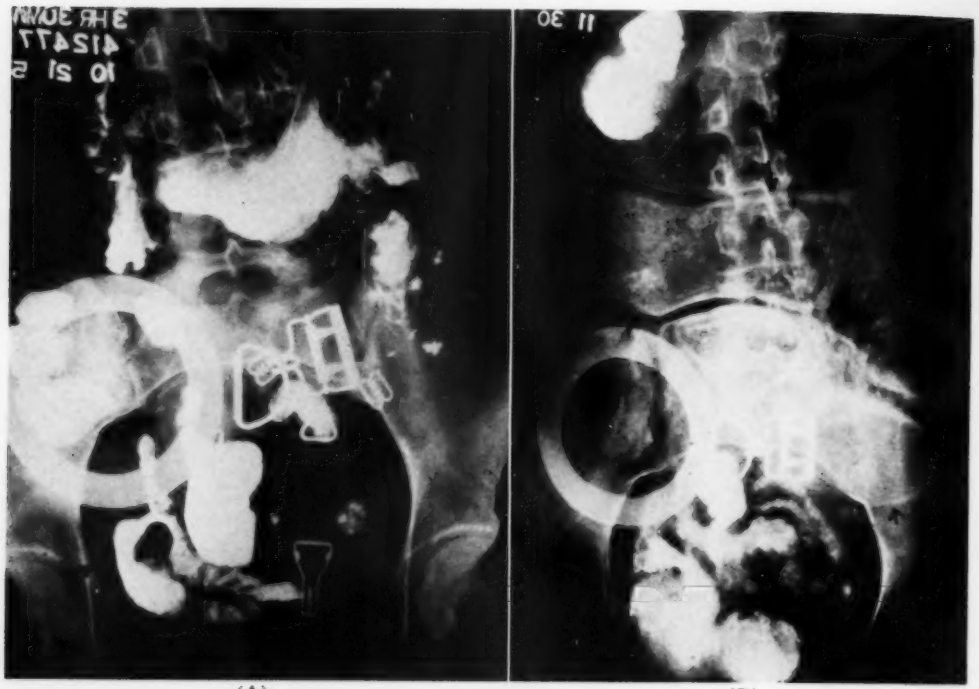
[2] See Addendum, page 547.

Fig. 3. Ileo-anal anastomosis following colectomy for ulcerative colitis (Unit No. 979118). A localized sacculation of the ileum just proximal to the anus simulates a rectal ampulla.

A 43-year-old woman (Unit No. 824865) had a normal ileum on x-ray examination and also at operation a few days later. Immediately after subtotal colectomy and ileostomy she had recurrent attacks of abdominal cramps, with gas distention of the small intestine, profuse ileostomy drainage, vomiting, electrolyte imbalance, dehydration, and prostration. The symptoms responded temporarily to intravenous infusions and to deflation with the Miller-Abbott tube. Roentgen examination during these episodes revealed gas-distended, dilated loops of ileum. Injection of barium through the ileostomy showed no evidence of obstruction or stricture; the dilatation extended to the stoma. The patient died about three months after the operation.

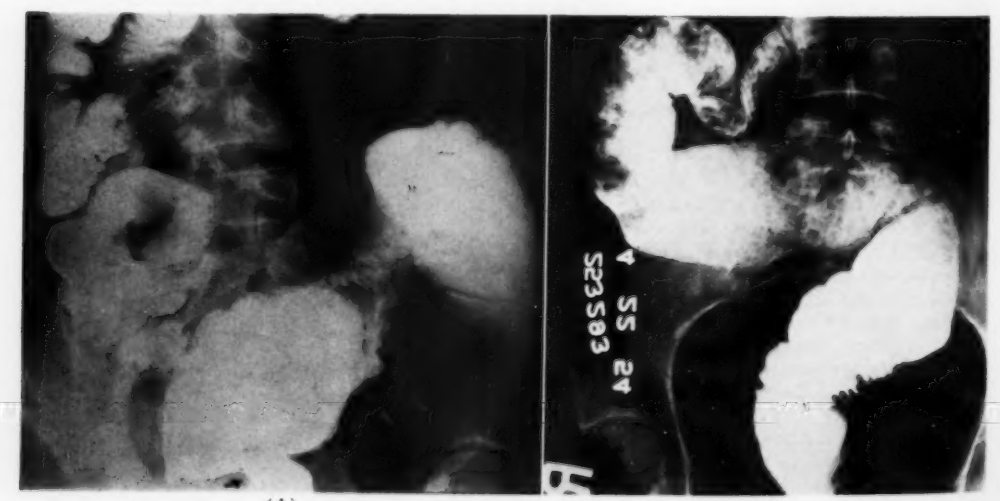
At necropsy purulent peritonitis resulting from two perforations of the ileum was found. The ileum was markedly dilated, particularly just proximal to the stoma, but no evidence of obstruction was discovered. The entire ileum was involved by an inflammatory process extending through all layers of the wall. The mucosa was ulcerated in numerous places. Two of the ulcers, about 70 cm. proximal to the stoma, were perforated. In other places the thickened mucosa formed polypoid masses. The mesenteric lymph nodes were greatly enlarged and showed microscopic evidence of lymphadenitis.

Group III includes 4 patients with megaileum secondary to chronic incomplete mechanical obstruction at or distal to the stoma.



(A) (B)

Fig. 4. Inflammatory disease and later dilatation of the ileum after colectomy and ileostomy for ulcerative colitis (Unit No. 778846).
A (left). Evidence of inflammatory disease of the ileum one and a half years after operation.
B (right). Dilatation of the ileum two and a half years after operation.



(A) (B)

Fig. 5. Persistence of ileal dilatation after relief of mechanical obstruction. A seventeen-year-old girl (Unit No. 774300) had an ileosigmoidostomy for Hirschprung's disease. The achalasic segment was not removed.
A (left). Seven years after the operation, the rectosigmoid is narrow (arrows) and the distal ileum is dilated.
B (right). One and a half years after removal of the rectum with the achalasic segment, and ileo-anal anastomosis. The dilatation of the ileum persists.

A 4-year-old boy (Unit No. 090288) had a subtotal colectomy with ileosigmoidostomy for Hirschsprung's disease. The achalasic segment in the rectosigmoid region was not removed. A stricture developed at the stoma, proximal to the achalasic segment, followed by dilatation of the ileum. Five and a half years postoperatively perforation of the ileum occurred. At operation for the repair of this perforation, the ileum measured 10 cm. in diameter. The regional mesenteric lymph nodes draining the segment in which the perforation occurred were very large. Shortly thereafter the sigmoid and rectum were removed and ileo-anal anastomosis was established. Roentgen examination one and a half years later showed moderate dilatation of the distal ileum; the caliber as shown by the barium shadows was about 6 cm., in contrast to the diameter of 10 cm. found by the surgeon at the second operation.

A 17-year-old girl (Unit No. 774300) had subtotal colectomy with ileosigmoidostomy for Hirschsprung's disease. The achalasic segment was not removed. Recurrent symptoms of chronic incomplete intestinal obstruction developed. Seven years after the operation, a barium enema disclosed marked narrowing of the rectum which was presumably part of the achalasic area (Fig. 5). The ileum was dilated so that proximal to the stoma it measured about 10 cm. in diameter. The rectum and remaining rectosigmoidal area were removed, and ileo-anal anastomosis was done. The distal ileum was described by the surgeon as dilated and hypertrophied, but no measurement was given. One and a half years following this operation, roentgen examination disclosed persistent dilatation of the distal ileum. The maximum width of the lumen was approximately the same.

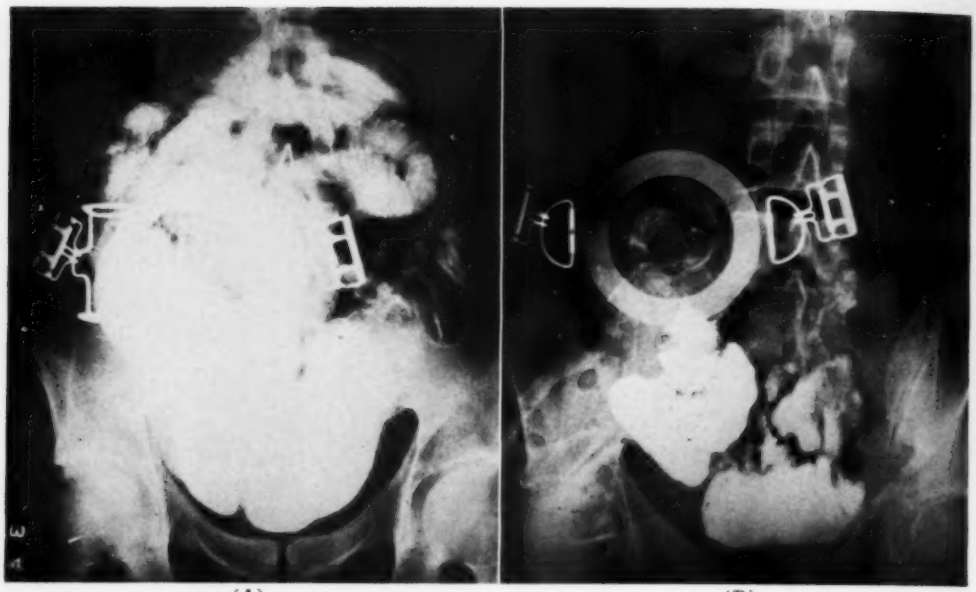
A 17-year-old boy (Unit No. 734143) had sigmoidocecostomy and resection of the colon from the hepatic flexure to the middle of the sigmoid for Hirschsprung's disease. The ascending colon remained as a blind pouch connected with the sigmoid through the sigmoidocecostomy. The achalasic segment in the rectosigmoidal region was not removed. Repeated barium examinations over a period of years following the operation disclosed the gradual development of dilatation of the ascending colon, the cecum, and the distal ileum. The barium-filled ileum averaged about 6 cm. and the remaining portion of the ascending colon about 12 cm. in diameter. In spite of this, the patient appears to be in a satisfactory clinical condition.

A 49-year-old man (Unit No. 012961) had subtotal colectomy and ileosigmoidostomy for congenital polyposis of the colon. A stricture at the anastomosis with dilatation of the ileum was demonstrated two months after the operation. The stoma was immediately revised, but the dilatation of the ileum persisted. A recent examination, approximately seven years later, showed stricture at the stoma and dilatation of the ileum still present. Another attempt to relieve this constriction will soon be made.

Fig. 6. Unexplained dilatation of the entire small intestine, rectum and sigmoid following colectomy and ileosigmoidostomy for multiple polyposis in a boy of eight years (Unit No. 963711). This is a seven-hour film following ingestion of barium, six years after the operation. The arrow indicates one of the polyps in the small intestine.

Group IV includes 2 cases of congenital polyposis, 1 of the colon and 1 of the stomach and small and large intestine, in which dilatation of the ileum occurred without evidence of obstruction.

An 8-year-old boy (Unit No. 963711) had a subtotal colectomy and ileosigmoidostomy because of multiple polyps in the large intestine. Subsequently, multiple polyps were found in the stomach and small intestine. One and a half years after the operation, dilatation of the entire small bowel was demonstrated. Six months later, because of symptoms consistent with intestinal obstruction, a second operation was performed. Numerous adhesions bound together the loops of small intestine, including the ileum. These loops were edematous and dilated, but no obstruction could be identified. The patient continued to have frequent unexplained episodes of transient abdominal pain. Several barium examinations disclosed persistent dilatation of the entire small intestine, and of the sigmoid and rectum (Fig. 6). Many polyps were demonstrated in the small intestine, but no evidence of intussusception was



(A) (B)

Fig. 7. Dilatation of the ileum with profuse ileostomy drainage following colectomy and ileostomy for multiple polyposis in a twenty-seven-year-old man (Unit No. 972797), followed by a return to normal.

A (left). Twenty-four hour film following the ingestion of barium, about one and a half years after operation. Dilatation and stasis were present in spite of a profuse fluid discharge from the ileostomy. No evidence of obstruction could be demonstrated by x-ray or at operation one month later.

B (right). The two-and-three-quarter-hour film after ingestion of barium one year after the second operation, at which the stoma was revised and some adhesions were divided. The ileum at this time was normal and the patient was symptom-free.

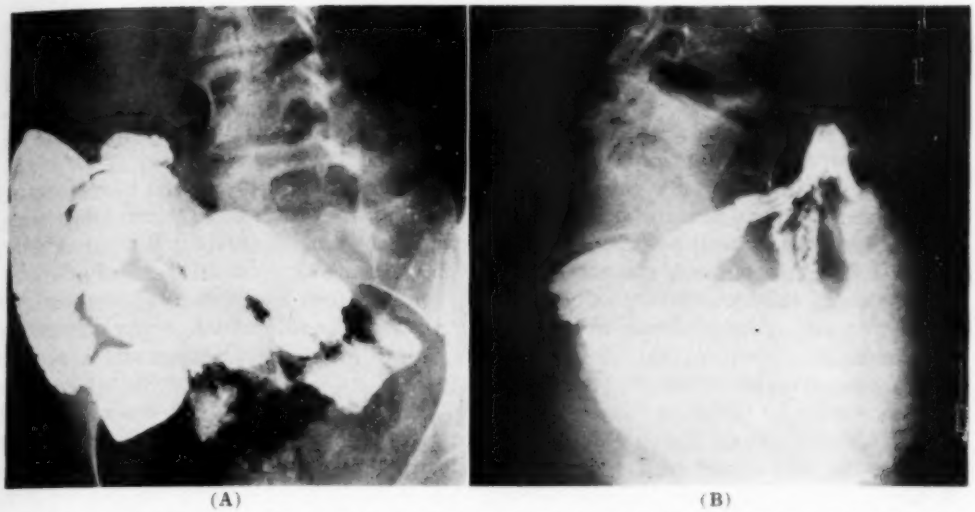
found. About five years after the second operation mechanical ileus developed. At the third operation a double intussusception led by two polyps was found in the ileum. The surgeon noted dilatation of the ileum below the level of the obstruction. Throughout this period the patient has had two to four semiformed bowel movements per day. During the attacks of pain, the bowel movements are reduced to one a day or one in two days.

A 27-year-old man (Unit No. 972797) had a total colectomy with ileoproctostomy. He had as many as eight semiformed stools daily, and excoriation of the perianal skin developed. Because of this, ileostomy was done two years after the first operation. About one and a half years later he began to have recurring attacks of crampy abdominal pain, nausea, vomiting, and copious liquid ileostomy drainage, which were temporarily controlled by bed rest and Banthine. A small-intestine and retrograde barium study during one of these episodes disclosed great dilatation of the ileum extending up to the stoma (Fig. 7). The hugely dilated ileum retained barium for thirty hours after it was ingested, in spite of the copious fluid discharge. No satisfactory explanation for this could be found. Following deflation with the Miller-Abbott tube, a third operation disclosed many adhesions involving the distal jejunum and the entire ileum. At this time the small intestine was not enlarged and did not appear abnormal except for the adhesions. No point of obstruction could be found. Some of the adhesions were severed, and the stoma was revised, although no constriction was present. Recovery was uneventful. A year after the third operation, a small-intestine study shows the ileum to be normal in size. The transit time is approximately three hours. The patient is symptom-free.

DISCUSSION

This study discloses nothing to support the idea that enlargement of the small intestine following colectomy occurs as a physiologic compensation for the loss of colon. The above described cases, on the other hand, suggest that enlargement of the ileum under these conditions must be regarded as abnormal.

Eight of the 9 patients in Group I who were symptom-free after ileostomy had a normal-sized ileum. In the patient with ileo-anal anastomosis a localized sacculation developed just proximal to the anus, grossly simulating a rectal ampulla. Rav-



(A) (B)

Fig. 8. Reversibility of intestinal dilatation in one of the patients (Unit No. 778846) with ileostomy dysfunction (Fig. 4) eight months following the previous examination. At this time the patient was without symptoms. During the interval between examinations she had been taking hydrocortone and high-vitamin supplements. A (left). Three-and-a-half-hour roentgenogram, showing normal size of proximal ileum. B (right). Five-hour roentgenogram, showing that dilatation persists only in a short segment of ileum just proximal to the ileostomy.

itch (12) believes that small-intestinal dilatation following ileo-anal anastomosis results from the fact that the sphincter acts to produce a source of intermittent obstruction. This seems a logical explanation, but in our case this physiologic obstruction was not severe enough to cause generalized ileal dilatation.

The effect of more severe, chronic unphysiologic obstruction is illustrated by the cases in Group III; for example, failure to excise the achalasic segment of the rectosigmoid in 3 cases of Hirschsprung's disease. In 1 of these, a considerable length of colon was left *in situ* and, despite the fact that this dilated to massive proportions, great enlargement of the ileum developed as well. In another case, stenosis of the ileosigmoidostomy produced an additional obstruction. In 2 of these 3 cases of Hirschsprung's disease, the original ileosigmoidostomy was changed to an ileo-anal anastomosis. Roentgen studies about one and a half years after the second operation showed that the caliber of the ileum had become smaller but some degree of dilatation persisted. In the fourth case in Group III dilatation of the ileum was found two months after ileosigmoidostomy, with a stricture at the anastomosis. Examination six years later disclosed no diminution in the size of the ileum and a stricture at the anastomosis was again demonstrated.

One patient in Group I (Unit No. 776989) originally had an ileo-anal anastomosis which was later changed to ileostomy because of stricture of the anal canal. The ileum of this patient did not dilate, but it should be noted that the stools were consistently liquid during the period of time that she had the ileo-anal anastomosis. Possibly this prevented the formation of sufficient pressure to produce ileal dilatation.

In Group II, 3 patients with ulcerative colitis illustrate the development of inflammatory disease of the ileum after ileostomy, characterized clinically by recurrent episodes of crampy abdominal pain, nausea, and vomiting. With these symptoms, the ileostomy drainage becomes fluid and alternately diminished and excessive. Introduction of a catheter into the ileostomy when drainage is diminished usually produces a copious fluid discharge, often with some relief of symptoms. In all 3 patients roentgen studies during these

painful episodes revealed dilatation of the ileum extending to the stoma, with no evidence of a mechanical barrier such as the strictures described in Group III.

The absence of a demonstrable cause for the intermittent diminution in the discharge was confirmed in 1 case by laparotomy and in another by autopsy. In spite of this, the clinical picture is consistent with an intermittent mechanical obstruction, and the fact that introduction of a catheter through the stoma yields copious drainage indicates that the barrier, possibly based on intermittent spasm, must be very close to the stoma. In fact, 1 patient stated that he could observe through the abdominal wall the progress of a peristaltic wave toward the stoma, and that the cramp stopped when the contraction reached the ileostomy. Fluoroscopic observation of this patient during a cramp disclosed that peristalsis did not pass through the terminal 15 cm. of ileum; instead, this dilated segment ballooned out even further as the height of the cramp was reached. Hiatt (9) believes that the abnormality is the result of interference with normal peristalsis through the terminal segment of the ileum. Two of the 3 patients in this group recovered with the parenteral administration of fluid, general nutritional improvement, and hydrocortone. The intermittent character of the symptoms is consistent with a transient derangement of the motor physiology, possibly a ring contraction of the ileum at the stoma.

This symptom complex is described by Warren and McKittrick (15) under the designation of ileostomy dysfunction, and occurred in 62 per cent of their group of 210 patients. They attribute the disorder to fixation of the distal ileum to the abdominal wall or to contraction of the stoma. Counsell and Goligher (4), in their description of the same condition, state that insertion of a catheter through the ileostomy is often followed by escape of some 200 to 300 ml. of ileal contents. In both reports the disorder is said to begin soon after operation. In 2 of our cases symptoms began in the immediate postoperative period, but the third patient was without symptoms for seven years after ileostomy and colectomy.

No constant relationship could be established between the onset of these episodes and the status of the blood electrolytes and proteins. During the acute phase the patients are dehydrated, and the parenteral administration of fluids containing proper amounts of sodium and potassium was followed by improvement in the hydration of the tissues and in electrolyte balance. In 1 patient (Unit No. 778846) the serum sodium was 140 and the potassium was 5.0 milliequivalents per liter at the onset of an attack, but at the onset of another attack the figures were 131 and 3.4 milliequivalents per liter, respectively. In the same patient the blood protein was 7.0 grams per cent at the onset of an attack. In another patient (Unit No. 824865), most acute episodes were attended by low sodium, potassium, chloride and protein levels; the lowest figures were: sodium 122, potassium 2.3, chloride 77.3 milliequivalents per liter, and proteins 5.4 gm. per cent. At the onset of another attack, however, this patient had normal blood electrolyte and protein levels.

Because of the variability of these figures at the onset, and because of the dehydration and loss of electrolytes which follow profuse liquid ileostomy drainage, it seems probable that the low figures are the result rather than the cause of the disorder.

Subsequent to the development of this syndrome, the intestine in 2 patients in Group II was examined at operation and autopsy, respectively; in both, the ileum was extensively involved by inflammatory disease. In addition, the mesenteric lymph nodes were greatly enlarged. In the experience of Warren and McKittrick, inflammatory disease of the remaining ileum was an infrequent and usually transient occurrence.

Both patients in Group IV had dilatation of the ileum and extensive peritoneal adhesions in this region. The one with

ileostomy resembled the patients in Group II so far as symptoms are concerned. Roentgen examination of this patient a month prior to operation disclosed marked ileal dilatation extending all the way to the stoma. The intestine was deflated with the Miller-Abbott tube. At operation, the ileum was normal in size; no evidence of inflammation or of mechanical obstruction was demonstrable. No satisfactory explanation for the dilatation of the ileum can be offered unless it is the result of a temporary derangement of motor physiology, the origin of which is not apparent. In the absence of a kink or knuckle, it seems hardly possible that the adhesions were responsible. Roentgen examination of this patient a year after operation showed the ileum to be still normal in size.

The other patient in Group IV had polyposis of the entire gastrointestinal tract, with widespread dense adhesions involving the entire small intestine. In this case the entire small intestine, the terminal portion of the sigmoid, and the rectum were dilated, and the dilatation persisted. This patient had repeated episodes of transient abdominal pain, the latest of which was proved at operation to be the result of a double intussusception which was successfully reduced. A satisfactory explanation for the persistent dilatation of the entire small intestine cannot be offered. The adhesions prevented adequate examination of the mesentery at operation.

No relation between the size of the ileum and an increase in its power to absorb water was found. In almost all of these patients, the stool assumed a semiformed consistency soon after operation; thereafter the consistency seemed to vary with dietary and emotional factors.

SUMMARY

Eighteen patients were examined by x-ray methods at various intervals after colectomy to find out what, if any, changes occurred in the ileum.

In 8 symptom-free patients, 6 with ileostomy and 2 with ileoproctostomy, no appreciable change in the size of the ileum could be detected.

In 1 patient with ileo-anal anastomosis, who had diarrhea controlled by Banthine, a sacculation of the distal ileum developed, simulating a rectal ampulla.

Ileal dilatation was found:

(1) In 4 patients with chronic incomplete intestinal obstruction resulting from stricture at the anastomosis with the sigmoid or the presence of the achalasic segment of colon which had not been resected.

(2) In 3 patients with ileostomy for chronic ulcerative colitis who experienced recurring attacks consistent with intestinal obstruction, though no organic obstruction could be demonstrated. These episodes were apparently the result of intermittent, unexplained localized motor dysfunction in the distal segment of ileum. In 2 of these patients, inflammatory disease of the ileum was demonstrated.

(3) In 2 patients with congenital polyposis in whom, following colectomy, dilatation of the small intestine developed, with transient symptoms consistent with intestinal obstruction. Both of these patients had widespread peritoneal adhesions. No satisfactory explanation for this dilatation can be offered.

In most of the patients the stool became semisolid soon after operation. No relation between increased absorption of fluid and the size of the ileum appeared to exist.

622 West 168 St.
New York 32, N. Y.

ADDENDUM

After this paper had been submitted for publication, we had an opportunity to examine one of the patients of the group with ileostomy dysfunction (Unit No. 778846, See p. 540) at a time when she was without symptoms. The disappearance of most of the abnormal findings was striking (Fig. 8).

REFERENCES

1. BEST, R. R.: Anastomosis of the Ileum to the Lower part of Rectum and Anus. Report on Experiences with Ileorectostomy and Ileoproctostomy, with Special Reference to Polyposis. Arch. Surg. **57**: 276–285, August 1948.

2. BEST, R. R.: Evaluation of Ileoproctostomy to Avoid Ileostomy in Various Colon Lesions. J.A.M.A. **150**: 637–642, Oct. 18, 1952.

3. BOEHME, E. J.: The Surgical Treatment of Familial Polyposis of the Colon. Report of Seven Cases, Six in One Family. Ann. Surg. **131**: 519–533, April 1950.

4. COUNSELL, P. B., AND GOLIGHER, J. C.: The Surgical Treatment of Ulcerative Colitis. Lancet **2**: 1045–1050, Nov. 29, 1952.

5. DENNIS, C., AND KARLSON, K. E.: Surgical Measures as Supplements to the Management of Idiopathic Ulcerative Colitis; Cancer, Cirrhosis, and Arthritis as Frequent Complications. Surgery **32**: 892–912, November 1952.

6. FERGUSON, L. K.: Surgical Treatment of Ulcerative Colitis. Postgrad. Med. **8**: 384–392, November 1950.

7. GARDNER, C.: Polyposis of the Colon. Arch. Surg. **56**: 75–78, January 1948.

8. GOLDEN, R.: Some Clinical Problems in Small Intestinal Physiology. Brit. J. Radiol. **23**: 390–408, July 1950.

9. HIATT, R.: Personal communication.

10. MUELLER, C. B., AND FISCHER, H. W.: Transplantation of the Ileum; Experimental Study. Surgery **30**: 477–483, September 1951.

11. RAVITCH, M. M., AND SABISTON, D. C., JR.: Anal Ileostomy with Preservation of the Sphincter. Proposed Operation in Patients Requiring Total Colectomy for Benign Lesions. Surg., Gynec. & Obst. **84**: 1095–1099, June 1947.

12. RAVITCH, M. M.: Anal Ileostomy with Sphincter Preservation in Patients Requiring Total Colectomy for Benign Conditions. Surgery **24**: 170–187, August 1948.

13. RAVITCH, M. M., AND HANDELSMAN, J. C.: One Stage Resection of Entire Colon and Rectum for Ulcerative Colitis and Polypoid Adenomatosis. Bull. Johns Hopkins Hosp. **88**: 59–82, January 1951.

14. STONE, H. B.: Interposition of a Loop of Ileum to Repair Defects in the Colon. Ann. Surg. **88**: 593–596, September 1928.

15. WARREN, R., AND MCKITTRICK, L. S.: Ileostomy for Ulcerative Colitis; Technique, Complications and Management. Surg., Gynec. & Obst. **93**: 555–567. November 1951.

SUMARIO

El Ileon Consecutivamente a la Colectomía

A 18 enfermos se les examinó con técnicas radiográficas a varios plazos después de la colectomía para descubrir qué alteraciones había habido, si las había, en el ileon. No reveló nada este estudio que apoyara la idea de que sobreviene hipertrofia del intestino delgado a continuación de la colectomía como compensación fisiológica por la pérdida del colon. Más bien indicó que la dilatación ileal en esas condiciones debe considerarse anormal.

En 8 enfermos asintomáticos, 6 con ileostomía y 2 con ileoproctostomía, no pudo descubrirse ninguna alteración apreciable en el tamaño del ileon.

En 1 enfermo con anastomosis íleo-anal, que padecía de diarrea dominada con Banthine, se formó una saculación de la porción distal del ileon, simulando una ampolla rectal.

Observóse dilatación rectal:

(1) En 4 enfermos con oclusión intestinal incompleta crónica debida a estenosis en la anastomosis con la S ilíaca o a la presencia del segmento achalásico del colon, que no había sido resecado.

(2) En 3 enfermos con ileostomía por colitis ulcerada crónica, que experimentaban ataques recurrentes compatibles con oclusión intestinal, aunque no pudo descubrirse obstrucción orgánica, esos episodios eran aparentemente la consecuencia de una inexplicada e intermitente disfunción motora localizada en el segmento distal del ileon. En 2 de estos pacientes, se descubrió enfermedad inflamatoria del ileon.

(3) En 2 enfermos con poliposis congénita, en quienes, después de la colectomía, se presentó dilatación del intestino delgado, con síntomas pasajeros compatibles con oclusión intestinal. Ambos tenían adherencias peritoneales muy difundidas. No puede ofrecerse explicación satisfactoria de esta dilatación.

En la mayor de los enfermos, las heces se volvieron semisólidas poco después de la operación. No parecía existir relación alguna entre la mayor absorción de líquido y el tamaño del ileon.

Roentgen Abnormalities of the Large and Small Intestine Associated with Prolonged Cathartic Ingestion[1]

NORMAN HEILBRUN, M.D., and CHARLES BERNSTEIN, M.D.

THE CATHARTIC habit is widespread and is commonly associated with colonic dysfunction or irritable colon. Seventy-three per cent of Jordan's patients with functional disturbances of the colon (1) and 44.5 per cent of a series reported by Collins (2) used cathartics and/or irritating enemas or colonic irrigations daily or frequently. The roentgen abnormalities described and accepted as associated with this condition are narrowing and diminished haustrations in the left colon with atonicity of the transverse and right colon segments or hypotonicity of the entire colon (3). In 1943, however, marked enterocolitic-like changes, different from those commonly associated with colonic dysfunction or irritable colon, were reported in a patient who had ingested irritant cathartics daily for twenty-six years (4). The proximal colon showed the most severe changes and the ileocecal valve and terminal ileum were also abnormal. This patient had never had diarrhea, blood in the stool, or crampy bowel movements. Her bowels would not move unless she took the irritant cathartics each day. Similar roentgen findings, ranging from mild to severe, have been recongized in additional cases. In all of these the common denominator has been the daily and continuous ingestion of irritant or drastic cathartics over a period of at least fifteen years. These patients cannot evacuate without the aid of cathartics.

It is the purpose of the present report to describe the clinical and roentgen findings in 9 patients falling into this group. Recently, Jewell and Kline have reported 2 additional cases (5). Similar roentgen abnormalities have been recognized by other radiologists to whom the original and subsequent cases were shown (6).

In the series being reported the early changes were in the cecum and ileocecal valve. As they became more severe and diffuse, they extended proximally to involve the terminal ileum and distally to involve the colon as far as the sigmoid. This is in contradistinction to the commonly accepted findings in colonic dysfunction or irritable colon.

Even though the roentgen findings suggested a colitic or enterocolitic process, the clinical histories of all of these patients were completely devoid of true diarrhea, crampy or frequent bowel movements, or bloody discharge except in the presence of rectal complications. All had ingested irritant cathartics for at least fifteen years. There were no abnormal constitutional findings associated with the abnormal bowel. Direct examination of the rectum and sigmoid revealed no evidence of active or old inflammatory disease suggestive of ulcerative or amebic colitis. At times the mucosa was described as somewhat edematous but it did not bleed easily nor was it unduly reddened. Melanosis coli was occasionally seen when cascara was used alone or in combination with other drugs.

ROENTGEN FINDINGS

The mildest cases showed findings limited to the cecum and the ileocecal valve. The cecum was somewhat foreshortened and conical. The valve had lost its normal beak-like appearance and the lips were shortened and gaping. When the changes were more severe, the colon distal to the cecum became tubular, with diminished haustrations. This change might extend as far as the lowermost portion of the descending colon. The sigmoid was not involved except in a single case with a localized rectal stricture due to lymphogranuloma venereum. Proximally, when the small intestine was involved, the ileum was

[1] From the School of Medicine, University of Buffalo. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

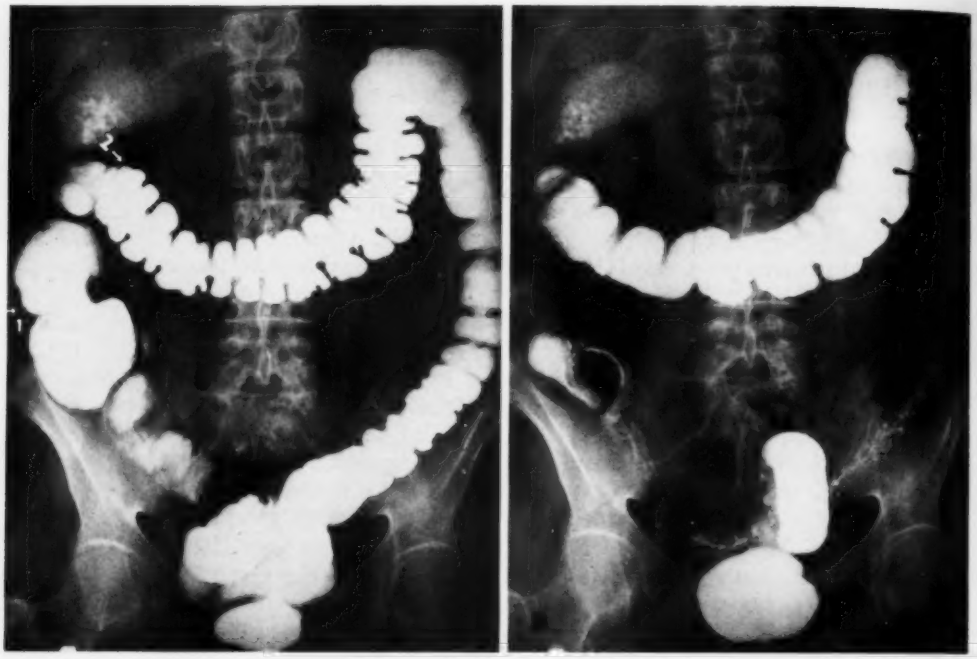


Fig. 1. Case II. A. Pre-evacuation study. The changes are limited to the cecum (arrow 1) and the ascending colon, where the haustrations are diminished, with smoothing of the walls. These represent the minimal changes observed. Beyond arrow 2 the colon is normal.
B. Post-evacuation study. Note the bizarre contractions of the cecum.

narrowed and tubular with loss of the normal mucosal markings. Frequently, in the more severe cases, the preliminary plain film studies showed the abnormal tubular outline of the gas-filled bowel segments.

There were no shaggy margins suggestive of ulceration. When the colon was contracted, the folds in the involved areas were linear, and none of the normal mosaic markings were seen. In those cases in which air had been insufflated, or trapped, the mucosa had a mottled appearance suggestive of edema, although the exact explanation for this was not clear.

Upon fluoroscopic examination at the time of the barium enema study, the rectal capacity was not found to be diminished and there was no evidence of significant shortening or rigidity of the rectum and sigmoid. In the one case in which there was a severe localized rectal stricture from lymphogranuloma venereum, the rectum and sigmoid were shortened and narrowed. These findings, aside from the stricture, were felt to be due to hypertonicity from the irritants and not to the local inflammation associated with the stricture. As the barium column flowed into the descending colon in the more pronounced cases, the tubular appearance of the bowel, with or without shortening of the flexures, became evident. Segments appeared spastic and narrowed, but these appearances were not constant and the bowel was moderately distensible, in contrast to the rigid, tubular bowel of long-standing or so-called "burnt-out" ulcerative colitis.

One might assume during fluoroscopy that inflammatory disease, such as ulcerative or amebic colitis, was present, but upon questioning the patient it was found that there had never been diarrhea or blood in the stool and that cathartics must be used, and had been taken daily for years, in order to get the bowels to move.

The following case reports will serve to illustrate the clinical and roentgen findings:

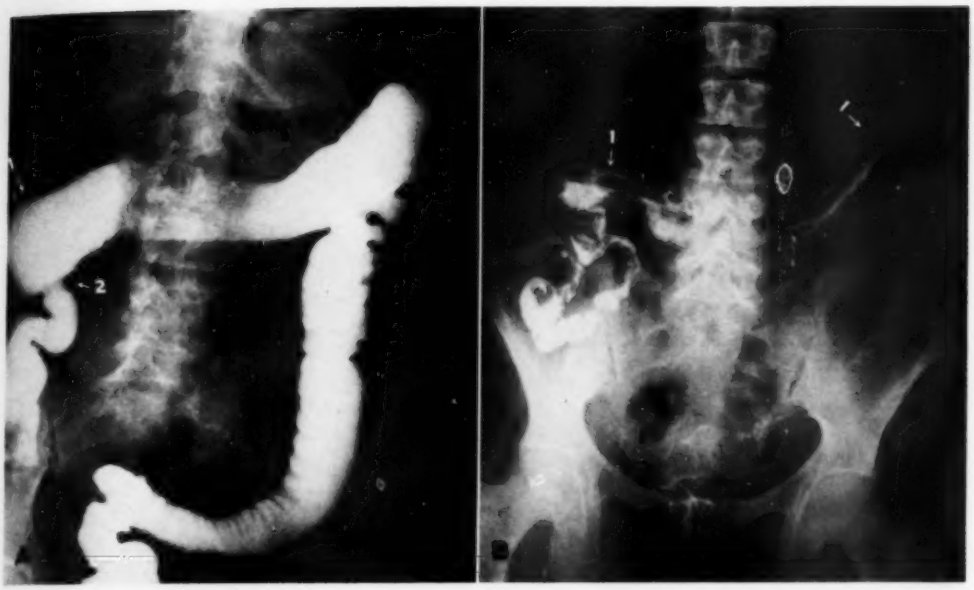


Fig. 2. Case III. A. Pre-evacuation study. The cecum is foreshortened (arrow 1) and the lips of the ileocecal valve are gaping (arrow 2). The colon, as far as the distal transverse segment, shows smoothing (arrow 3). B. Post-evacuation study. Note the bizarre mucosal pattern between the arrows.

CASE I: The roentgen findings in this 50-year-old white married female were first reported in 1943 (4). Following a period of hospitalization for thirty days during which all cathartics were stopped, the roentgen abnormalities diminished mildly. Since resumption of cathartics, however, the roentgen findings are similar to those originally described.[2] For twenty-six years, 2 to 3 pills of a proprietary which contained the following ingredients were taken daily:

Extract cascara	0.015 gm.
Aloin	0.015 gm.
Podophyllin	0.015 gm.
Phenolphthalein	0.030 gm.

Subsequently, up to the present, 2 pills of a different proprietary containing the following ingredients have been taken daily:

Aloin	0.015 gm.
Podophyllin	0.015 gm.
Extract cascara	0.015 gm.

The patient never has had formed stools. Her general health is good. The sigmoidoscopic examination revealed slight mucosal edema.

CASE II: A 76-year-old white female complained of constipation all of her life. For twenty-five to thirty years prior to her death she had taken daily 2 or 3 pills of a proprietary which contained the following:

Aloin	0.015 gm.
Podophyllin	0.006 gm.
Bitter cascara	0.023 gm.

Two roentgen examinations of the colon at an interval of two years showed similar findings (Fig. 1). The sigmoidoscopic examination was negative.

CASE III: A 43-year-old unmarried white female began to experience constipation following an appendectomy in 1923. In 1931 she began using a proprietary containing the following:

Phenolphthalein	0.060 gm.

and another containing

Aloin	0.015 gm.
Phenolphthalein	0.030 gm.

She alternated these nightly for eight to ten years. Following this, for two years she took 2 pills of the second preparation every night. From 1941 to 1946 she used enemas exclusively. She then resumed use of the second preparation, taking 3 or 4 pills every second or third night. In 1951 she cut this to 2 pills every night, with the addition of a teaspoonful of a bulk cathartic. The sigmoidoscopic examination was negative.

CASE IV (Fig. 3): Twenty-five years ago a 52-year-old married colored female started to use 2 to

[2] The roentgenograms in this case were published in Radiology 41: 486–491, November 1943. The reader is referred to the case report.

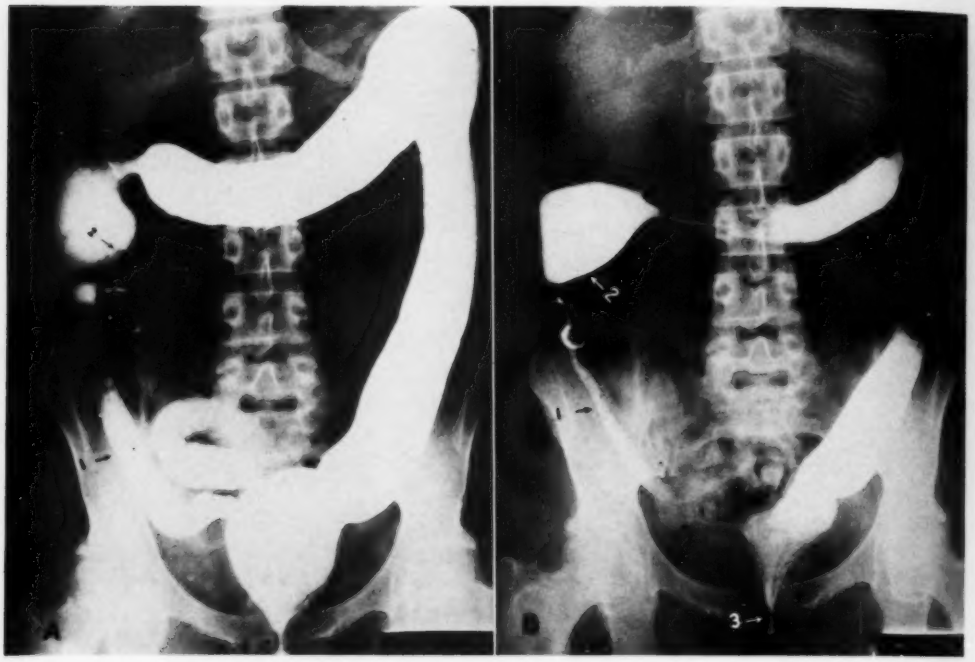


Fig. 3. Case IV. Pre-evacuation (A) and post-evacuation (B) studies. The entire colon, the terminal ileum (arrow 1), and the ileocecal valve (arrow 2) are all abnormal. There is a stricture of the rectum, 1.0 cm. in length, due to lymphogranuloma venereum (arrow 3). The colon is shortened, especially the sigmoid, with complete absence of haustrations. Note the variable areas of contraction.

3 pills every day of a proprietary cathartic containing

Aloin	0.015 gm.
Podophyllin	0.010 gm.
Extract cascara	0.015 gm.

For the last fifteen years she had had soreness in the rectum due to a stricture from lymphogranuloma venereum. The Frei test was positive. Surgery had been performed four years earlier and again a year before admission for the rectal stricture. At the time of the last operation, a proctoscopic examination showed some melanosis but no evidence of mucosal changes suggestive of inflammatory disease.

During the past year the patient had omitted the pills for two weeks. Cramps and fullness developed, but the bowels did not move during this time. Bleeding was occasionally noted when the stricture became fissured.

CASE V (Fig. 4): Because of irregular elimination, a 70-year-old married white female began, twenty years ago, to use one compound pill of mild mercurous chloride daily. On occasions she took 2 pills. Sigmoidoscopic examination was negative. Following the original roentgen examination the patient stopped using the pills and changed to a bulk cathartic with vitamin B_{12}. She now has normal evacuation and has gained 10 pounds. A colon study fourteen months after ingestion of the irritants was discontinued showed residual abnormality of the ileocecal valve and cecum. The colon distal to the cecum was now normal on pre- and post-evacuation studies. The active ingredients of the pill were:

Calomel	0.060 gm.
Extract colocynth compound	0.075 gm.
Resin jalap	0.020 gm.
Gamboge	0.015 gm.

CASE VI (Fig. 5): A 60-year-old married female started to take 2 or 3 proprietary cathartic pills daily about twenty-five years ago. The active ingredient was aloin, 0.015 gm. Sigmoidoscopic examination was negative.

This patient had a laparotomy for a tumor of the head of the pancreas which was found to be inoperable. Palpation and inspection of the cecum and ascending colon revealed no gross external abnormalities. No autopsy could be obtained.

The 3 remaining patients in this series took the same proprietary, which contained the following active ingredients:

Fig. 4. Case V. A. Pre-evacuation study. The entire colon shows lack of haustrations. The cecum is tubular (arrow 1).

B. Post-evacuation study. The abnormal ileocecal valve becomes evident (arrow 1). The mucosal pattern of the descending colon is linear, indicating increased tone (arrow 2).

C. Post-evacuation study one year following cessation of cathartics. The cecum is less spastic but still abnormal, and the ileocecal valve lips are still gaping. The mucosal pattern of the descending colon is essentially normal.

Aloin	0.015 gm.
Podophyllin	0.010 gm.
Extract cascara	0.015 gm.

One patient (Case IX) alternated at irregular intervals with three pills, each of which contained Extract cascara, 0.300 gm. The clinical and roentgen findings in these cases were similar to those which have been described and illustrated above.

Table I summarizes the cathartic habits of the entire group.[3] Unfortunately no pathological specimens were obtained. In 2 cases, however, there were operative findings. The case reported originally in 1943 showed thickening of the cecum at the time of laparotomy, described by the surgeon as compatible with tuberculosis, but there were no other findings suggesting

[3] The normal dose in grams is listed in parentheses below each drug. The other figures designate the doses of all the active ingredients contained in any single proprietary pill.

TABLE I: DRUGS HABITUALLY USED IN NINE CASES*

Case	No. of Years of Cathartic Habit	No. of Pills Daily	Drugs							
			Phenolphthalein (0.060)	Aloin (0.015)	Podophyllin (0.010)	Ext. Cascara (0.300)	Calomel (0.012)	Ext. Colocynth Comp. (0.250)	Jalap Resin (0.125)	Gamboge (0.125)
1	26, 13 } 39	2–3, 2	0.030	0.015	0.015	0.015				
			...	0.015	0.015	0.015				
2	25	2–3	...	0.015	0.006	0.023				
3	23, 8 } 31	2–3–4, 1–2	0.030, 0.060	0.015	...					
4	25	2–3	...	0.015	0.010	0.015				
5	20	1–2	...	...	...	...	0.060	0.075	0.020	0.015
6	25	2–3	...	0.015						
7	35	2	...	0.015	0.010	0.015				
8	15	2	...	0.015	0.010	0.015				
9	40	2–3	...	0.015	0.010	0.015				
	40	3	...	...	...	0.300				

* The normal dose in grams is listed in parentheses below the name of the drug. The other figures designate the doses of the active ingredients contained in any single proprietary pill.

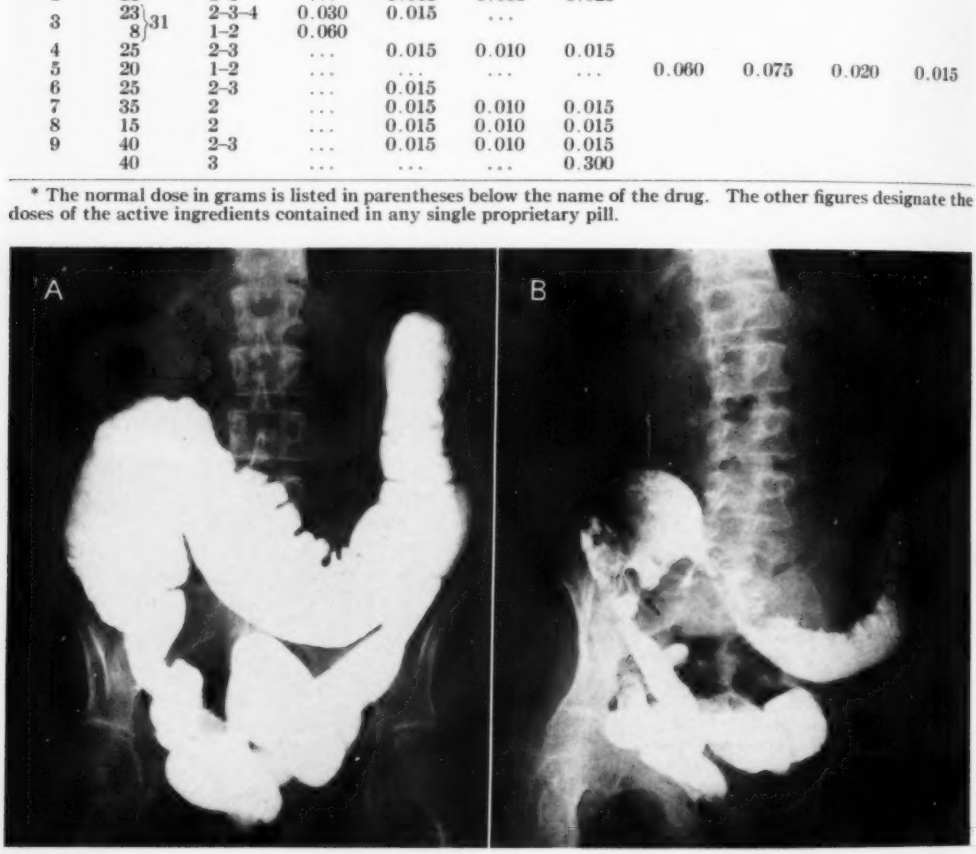


Fig. 5. Case VI. A. Pre-evacuation study. Changes are limited to the colon, from the cecum to the proximal transverse area (arrow). The cecum is shortened and the haustrations as far as the transverse colon are absent.

B. Post-evacuation study. The ileocecal valve is foreshortened (arrow). The cecum is also shortened and hypertonic.

intra-abdominal tuberculosis. Nor was there any evidence of pulmonary tuberculosis at that time or up to the present. In the absence of these findings, it seemed reasonable that the bowel thickening could have been due to hypertonicity.

In the second patient, with an inoperable cancer of the pancreatic head, the entire large bowel and terminal ileum were carefully inspected at the time of laparotomy. No abnormalities in the external appearance of the large or small bowel or their attachments were noted.

DIFFERENTIAL DIAGNOSIS

These hypertonic states of the bowel must be differentiated from the inflammatory lesions which they simulate on

roentgen examination. With inflammatory conditions, as a rule, there is a clinical history of diarrhea and cramps with or without blood in the stools, in contrast to the absence of true diarrhea or cramps in the group being considered. When the changes are limited to the cecum and proximal colon, they could be confused with active amebic colitis (7) and right-sided ulcerative colitis (8). There are, however, no amebae in the stools, and the proctoscopic examinations are negative. As the changes become more extensive, with spread to other areas of the large and small intestine, chronic ulcerative colitis with or without so-called "backwash" ileitis and regional enteritis must be differentiated from them. It is unusual for extensive chronic ulcerative colitis to occur without rectal or sigmoid involvement. In the cases being discussed, with the one exception noted above, the rectum and sigmoid showed no abnormalities. There was no evidence of ulceration along the margins of the barium column. This might cause confusion with "burnt-out" chronic ulcerative colitis.

Against tuberculosis are the negative roentgen findings in the chest and the negative sputum.

PHARMACOLOGY

The active cathartic ingredients of the preparations used by these patients are classified pharmacologically as stimulant or irritant cathartics (9). In the vegetable group the mildest of these are the emodins, such as cascara sagrada and aloes. They act for the most part upon the large intestine, irritating the mucosa and reflexly stimulating increased muscular activity and propulsion. The potent resins of podophyllin, jalap, colocynth, and gamboge are more irritating and are usually classified as "drastics." Their site of action is in the small intestine, where they cause increased motility. The coordinating reflexes of the small intestine are such that, when this occurs, increased motility of the large bowel follows almost at once (10). Phenolphthalein and calomel are chemical irritants. The former forms a soluble salt which acts largely on the colon but may also affect the small intestine. The latter becomes partly changed to mercuric oxide in the small intestine and the mercuric ion, being irritating, causes increased motility.

Thus the sites of action of the mild and more severe of the irritating drugs used in these cases correspond to the localization of the roentgen findings. The patient ingesting the more irritant resins and chemicals will show changes in the small bowel as well as the large. Those taking the milder drugs will show changes in the cecum, the proximal colon, and the ileocecal valve. The bulk or saline cathartics do not cause similar roentgen abnormalities.[4]

The active principles of the cathartics used act directly upon the mucosa of the small and large intestine. Their irritant action reflexly stimulates increased muscular activity and tonus. With high levels of tonus, the motility of the bowel is seriously impaired. In the face of persistent hypertonicity, the motility patterns become incoordinated and reduced in amplitude and frequency (11). Such states lead to constipation from slowed intestinal transport. Thus a vicious circle is established by the need for the continuous daily ingestion of a mucosal irritant strong enough to stimulate the bowel musculature reflexly to overcome the incoordinated muscular action due to hypertonicity.

The majority of the proprietary mixtures used were composed of combinations of the milder emodin and the more drastic resinous cathartics. Others contained the irritant chemicals, calomel or phenolphthalein, with one or more of the vegetable irritants in combination. Only a few contained a single active ingredient.

The amount of any single active ingredient contained in the proprietary mixtures used by these patients is the usual normal dose prescribed in the *Pharmacopeia* (12) or *National Formulary* (13). Most of the preparations contained two to four active

[4] A patient recently seen who had taken salines daily for twenty-five years showed no roentgen abnormalities.

ingredients, some more irritating than others. Thus each pill represented, as a rule, two to four times the normal cathartic dose. Beside this, each patient usually took 2 to 3 pills daily. This greatly augmented the cathartic effect.

It is suggested that this constant and continuous overdosage for so many years is responsible for the roentgen manifestations, namely, the simulation of enterocolitis resulting from the constant and protracted hypertonicity of the affected segments of the large and small intestine.

SUMMARY

A series of 9 cases is reported with roentgen abnormalities simulating enterocolitis, but due to hypertonicity resulting from the daily and continuous ingestion of irritant cathartics for at least fifteen years. Clinically, there was absence of diarrhea, cramps, and bloody bowel movements, and the physical and proctoscopic examination were essentially negative.

The roentgen findings are to be differentiated from inflammatory disease affecting the small and large intestine as well as from colonic dysfunction or irritable colon.

REFERENCES

1. JORDAN, S. M.: Colonic Dysfunction. New York State J. Med. **49:** 1802–1807, Aug. 1, 1949.
2. COLLINS, E. N.: The Diagnosis and Treatment of Irritable Colon. M. Clin. North America **32:** 398–407, March 1948.
3. (*a*) KANTOR, J. L.: Common Affections of the Colon: Their Origin and Their Management. Bull. New York Acad. Med. **5:** 757–788, August 1929.
(*b*) JORDAN, S. M., AND KIEFER, E. D.: The Irritable Colon. J.A.M.A. **93:** 592–595, Aug. 24, 1929.
(*c*) SPRIGGS, E. I.: Functional Disorders of the Colon. Quart. J. Med. **24:** 533–565, July 1931.
4. HEILBRUN, N.: Roentgen Evidence Suggesting Enterocolitis Associated with Prolonged Cathartic Abuse. Radiology **41:** 486–491, November 1943.
5. JEWELL, F. C., AND KLINE, J. R.: The Purged Colon. Radiology **62:** 368–371, March 1954.
6. (*a*) GOLDEN, R. (*b*) SEIBEL, R. E. (*c*) SEAGRAVES, K. E. (*d*) BERENS, D. (*e*) FLEISCHNER, F. G.: Personal communications.
7. GOLDEN, R., AND DUCHARME, P.: The Clinical Significance of Deformity of the Cecum in Amebiasis. Radiology **45:** 565–580, December 1945.
8. CROHN, B. B., GARLOCK, J. H., AND YARNIS, H.: Right-Sided (Regional) Colitis. J.A.M.A. **134:** 334–338, May 24, 1947.
9. GOODMAN, L., AND GILMAN, A.: The Pharmacological Basis of Therapeutics. New York, The Macmillan Co., 1941, pp. 798–801.
10. TRAVELL, J.: The Colon: Its Normal and Abnormal Physiology and Therapeutics. Ann. New York Acad. Sc. **54:** 416–425, July 15, 1954.
11. POSEY, E. L. JR., AND BARGEN, J. A.: Observations of Normal and Abnormal Human Intestinal Motor Function. Am. J. M. Sc. **221:** 10–20, January 1951.
12. Pharmacopeia of the U. S. A., Fourteenth Revision, Easton, Penna., Mack Printing Company, 1950.
13. The National Formulary, VIII. Washington, D. C. American Pharmaceutical Association, 1946.

685 Delaware Ave.
Buffalo 9, N. Y.

SUMARIO

Anomalías Roentgenológicas del Intestino Grueso y del Delgado Asociadas con la Prolongada Ingestión de Catárticos

Preséntase una serie de 9 casos de anomalías roentgenológicas que simulaban enterocolitis, pero debidas a hipertonía proveniente de la ingestión diaria y continua de catárticos irritantes (cáscara sagrada, áloe, podofilina, jalapa, coloquíntida, cambogia, calomelanos, fenolftaleína) a lo menos durante quince años. clínicamente, no había diarrea, tenesmo o melena, y el examen físico y proctoscópico resultó esencialmente negativo.

Los hallazgos roentgenológicos tienen que ser diferenciados de los de la enfermedad inflamatoria que afecta el intestino grueso y delgado y de los de la disfunción colónica o del colon irritable. En los casos más leves, las alteraciones se limitan al ciego y a la válvula íleocecal. El ciego aparece algo escorzado y cónico. La válvula pierde su aspecto rostrado normal y los labios están acortados y abiertos. Si las alteraciones son más graves, la porción del colon distal al ciego se vuelve tubular, y disminuyen los haustros. A falta de afección rectal como complicación, no se afecta la S ilíaca. El ileon puede estar estrechado y tubular, con pérdida de las marcas normales en la mucosa.

Benign and Malignant Tumors of the Duodenum[1]

EUGENE FREEDMAN, M.D., MARCUS H. RABWIN, M.D., and MARCELLA SAVA, M.D.

WHEREAS DURING the past three or four decades surgical and autopsy reports of tumors of the duodenum have been published with increasing frequency, most of these were unexpected findings either during surgery or postmortem. Though many of these cases had been studied radiologically, the lesions were either overlooked or mistaken for other conditions. The diagnosis was usually chronic postbulbar ulcer and in some instances, surprisingly enough, duodenal diverticulum (1).

Until about ten years ago, the radiological literature on duodenal tumors was very scant. Only more recently have there been a few publications dealing with the roentgen signs of the lesions and reporting cases diagnosed radiologically before operation or autopsy.

Some of the difficulties of roentgen diagnosis are of a technical character. The duodenum is not so easily and completely outlined and coated with barium as the stomach and colon. Peristalsis moves the contrast material along rapidly, interfering with continuous visualization of the neoplasm for easy recognition. Furthermore, since lesions in the second and third portions of the duodenum are infrequent, this part of the intestinal tract is often not as carefully investigated as it should be. Yet it is of utmost importance to recognize these tumors early, since the Whipple operation, proved to be a failure in the treatment for carcinoma of the head of the pancreas for which it was originally devised, promises to offer an excellent surgical approach to primary malignant tumors of the duodenum or ampulla of Vater.

INCIDENCE

According to Schwartz *et al.* (2), only 483 well documented cases of primary carcinoma of the duodenum were reported in the literature up to 1951. Eger (3) in 1933, and more recently Kleinerman *et al.* (1) in 1950, reviewed the literature dealing with the frequency of duodenal carcinoma in postmortem material. In over 350,000 autopsies, they found the incidence of primary carcinoma of the duodenum to be 0.033 per cent.

Three hundred and five proved cases of duodenal carcinoma collected from the literature by Eger showed the following anatomical distribution: 24 per cent in the first portion, 62 per cent in the second portion, 12 per cent in the third portion, and 2 per cent involving the entire duodenum. The difficulty of histologic differentiation between pancreatic, biliary, and duodenal tumors was believed by this writer to account in part for the high tumor incidence in the second part of the duodenum.

Benign tumors of the duodenum are also infrequent. In 1928, Golden (4) discovered 17 cases of non-malignant tumor of the duodenum in the world literature, to which he added 2 of his own. Rankin and Newell (5), reviewing 35 benign small intestinal tumors resected at the Mayo Clinic, found 10 in the duodenum. The largest series in the literature was reported in 1945 by Hoffman and Grayzel (6), who found 14 benign duodenal tumors in a review of 64,300 surgical specimens and 4,480 autopsy cases, an incidence of 0.0002 per cent.

Patients with carcinoma of the duodenum are usually in the sixth decade of life. The average age in one series (7) was fifty-three years, in another (8) fifty-five years. Benign tumors of the duodenum occur mainly in younger persons, the average age being given as thirty-six years by Rankin and Newell.

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[1] From the Departments of Radiology and Surgery, Cedars of Lebanon Hospital, Los Angeles, Calif. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

SYMPTOMATOLOGY

The clinical picture of a primary tumor of the duodenum is not characteristic, including various symptoms referable to the stomach, gallbladder, and pancreas. The indefinite symptomatology and the rarity of the lesions account for the fact that they are not usually considered in the clinical differential diagnosis.

According to Kleinerman *et al.*, the symptoms of duodenal carcinoma can be grouped into 4 categories:

1. The obstructive type, causing epigastric distress, nausea, vomiting, and weight loss. The frequency and character of the bowel movements are usually not altered.

2. The ulcerating type, with bleeding, weakness, and fatigue; in some instances with dramatic onset, hematemesis, syncope, and exsanguination.

3. The posterior penetrating type, with gnawing distress several hours after meals, varying from a mild feeling of fullness to cramp-like colicky pains. The pain may be relieved by vomiting but does not usually respond to ingestion of food, milk, and alkalis.

4. The bile-duct-obstructing type, with development of jaundice. This is a very late manifestation of periampullary duodenal carcinoma in contradistinction to primary carcinoma of the ampulla of Vater.

A palpable abdominal mass is rarely present.

According to Dixon *et al.* (8), symptoms can be present over a relatively long period of time. In their series there was an average history of about one year prior to admission.

Benign tumors of the duodenum can be completely silent clinically, and their presence may be discovered only on unrelated or routine gastrointestinal x-ray studies or at autopsy. In Rankin and Newell's series, symptoms averaged about eight years duration prior to surgery. The tumors may cause bleeding and obstruction. Occasionally they present clinical symptoms suggesting a chronic duodenal ulcer.

HISTOLOGY

Most of the malignant tumors of the duodenum are carcinomas, in contradistinction to the jejunum and ileum, where sarcomas predominate. By far the most frequent type is the cylindrical-cell adenocarcinoma arising from the intestinal mucosa. Dewis and Morse (9) described a hard, fibrous, scirrhous form of adenocarcinoma having few cells and abundant stroma, a softer medullary form having many cells and little stroma, and the colloid form with mucoid degeneration of the cells.

Berger and Koppelman (10) classify duodenal carcinomas topographically as suprapapillary, peripapillary, and infrapapillary, on the basis of their embryologic derivation. The suprapapillary portion of the duodenum is derived from the foregut, the infrapapillary portion arises from the midgut (yolk sac), while the region of the papilla represents the intervening zone. Raiford (11) divides tumors of the duodenum into 2 groups, based on the gross anatomical appearance:

1. Annular concentric tumors, most of which are malignant.

2. Asymmetric, eccentric tumors, which either extend exophytically from the wall of the duodenum or protrude into the intestinal lumen. The benign tumors of this group usually grow into the lumen, the mucosa offering less resistance than the muscularis and serosa. Most of the lesions extending both into and outside of the duodenum are malignant.

Metastasis from primary carcinoma of the duodenum is infrequent. The periduodenal lymph nodes, mesentery, liver, and lungs are the usual sites, in the order mentioned.

The largest group of benign tumors is represented by the adenomas. Others are myomas, lipomas, hemangiomas, neurogenic tumors, pancreatic rests, and hypertrophied Brunner gland structures.

RADIOLOGICAL DIAGNOSIS

The only valuable basis for the diagnosis of duodenal tumors is offered by

roentgen studies. Unfortunately these too have been unreliable and do not always yield unequivocal results, as shown by the pertinent literature.

Hoffman and Pack report that in 18 cases of proved carcinoma of the duodenum, the correct diagnosis was determined in only 2 cases, even though 16 were studied radiologically. On the other hand, in a series of 20 cases, Dixon *et al.* (8), while unable to predict the actual pathological nature of the lesion, established the existence of a duodenal tumor in every instance.

The radiological findings vary with the character, location, and extent of the tumor, but basically the same criteria apply as in the roentgen diagnosis of malignant lesions elsewhere in the intestinal tract. Patients with very early lesions may not show any abnormalities. However, in most patients presenting clinical symptoms, the tumor is in a sufficiently advanced stage to provide positive roentgen findings.

The typical benign tumor presents a well defined, regular filling defect, usually circular, sometimes multilocular, within the barium-filled duodenum. There may be stretching and even ulceration, but never frank destruction of the mucosal surfaces. The presence of a pedicle favors a benign lesion.

Since carcinoma of the duodenum originates in the mucosa, the first change is an irregular alteration and subsequent disappearance of the normal mucosal pattern. Later, when the mucosa becomes eroded, an irregular crater develops, around which the wall of the duodenum is thickened and fixed. Gradually the lesion extends into the lumen of the duodenum, producing an asymmetrical narrowing. The concentric and symmetrical constrictions are usually encountered with the scirrhous type of carcinoma. In some instances, where the destruction of the muscularis by the infiltrating tumor leads to a localized weakening of the duodenal wall, the lumen may become dilated rather than narrowed. Yet, while the duodenal lumen may be expanded by the growing tumor, the duodenal sweep does not become widened as in the presence of masses in the head of the pancreas.

In the far advanced stage, when the duodenal lumen is almost completely obliterated, the duodenal segment proximal to the obstruction and eventually even the stomach become dilated, first with hyperactive obstructive peristalsis, followed by paralytic distention.

In the differential diagnosis of primary tumor of the duodenum, the conditions which must be given most careful consideration are neoplastic lesions of the head of the pancreas, of the ampulla of Vater, of the gallbladder, and of the common duct. Metastatic tumor in the periduodenal lymphatics may extrinsically involve the duodenum in such a manner as to simulate a primary duodenal lesion. Occasionally, annular pancreas presents the radiologic appearance of a constricting carcinoma of the duodenum. Finally, chronic benign postbulbar ulceration may so closely resemble an ulcerating neoplasm that accurate preoperative differentiation is impossible.

Carcinoma of the head of pancreas usually exerts pressure from without, first spreading and enlarging the duodenal loop before invading the intestinal wall. Early carcinoma of the ampulla of Vater typically produces a localized defect on the medial wall of the second portion of the duodenum. In this stage, it is indistinguishable radiologically from early primary periampullary duodenal cancer. Here the fact that jaundice occurs early with tumor of the papilla and late with duodenal neoplasm serves as a clinical point of differentiation.

The inverted figure-of-3 sign described by Frostberg (12) may be found in tumor or inflammatory swelling of the head of the pancreas or the ampulla, but is not seen with duodenal carcinoma.

It is evident that in the late stages of carcinoma of the pancreas and biliary tract, infiltration and ulceration of the duodenum may become so extensive that all differ-

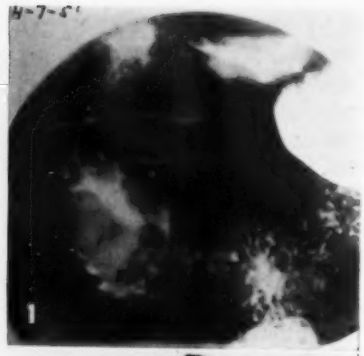


Fig. 1. Case I. The periampullary portion of the duodenum is dilated, the mucosal folds are distorted, and there is a slit-like ulcer crater in the central part of the lesion.

Fig. 2. Case I. Photograph of the locally excised polypoid carcinoma of the duodenum, showing central ulceration.

ential features between intrinsic and extrinsic tumor become lost.

Because of its developmental nature, annular pancreas is more commonly encountered in young persons. The constriction is usually concentric and regular; the mucosal pattern is normal, and ulceration does not develop. In adults, this condition may present considerable dilatation of the proximal duodenum and the stomach.

Chronic duodenal ulcer in a postbulbar location poses another, quite difficult problem of differentiation. Because of the rare incidence of primary duodenal carcinoma, many of the supra-ampullary tumors have been misinterpreted as chronic duodenal ulcers. On the other hand, swelling and edema of the mucosa around a benign ulcer may produce a radiological appearance indistinguishable from carcinoma. Some help in differentiation is derived from re-check examinations, which usually show healing and good response of a benign ulcer after medical treatment.

SURGICAL ASPECTS

Benign tumors of the duodenum can usually be treated by local excision. Some type of biliary shunt operation may be necessary in addition if there is common duct obstruction or if the reconstruction of the duodenum following local excision embarrasses the patency of the ampulla.

Radical pancreaticoduodenectomy appears to offer the only chance for cure in cases of primary carcinoma of the duodenum. Unfortunately the lesion is too frequently inoperable. Under these circumstances, palliative procedures such as gastroenterostomy or cholecystojejunostomy will contribute a great deal to the patient's comfort. If the lesion is resectable, however, radical operation should be undertaken, particularly if the location is in the first or second portion of the duodenum.

For early infra-ampullary carcinomas of the duodenum, Shallow *et al* (13) suggest that segmental resection with duodenojejunal anastomosis is adequate. They report 1 patient alive and well after three years. Ebert *et al* (14), however, report 2 similar cases with local recurrence and death in both instances.

It is our opinion that pancreaticoduodenectomy is the procedure of choice in all operable cases of primary carcinoma of the duodenum.

CASE REPORTS

We are reporting 5 proved cases of primary carcinoma of the duodenum and several cases of benign tumor of the duodenum. Of the primary carcinomas, 3 were seen at Cedars of Lebanon Hospital

and 2 at St. Francis Hospital in Los Angeles. Four of the 5 patients had a gastrointestinal x-ray study before operation, and the diagnosis of tumor of the duodenum was established in every case, although the question as to whether the tumors were benign or malignant was not settled. We are also adding case descriptions of postbulbar ulcers as well as tumors of the pancreas with secondary invasion of the duodenum, to demonstrate the occasional similarity of the radiological findings in these conditions.

CASE I: F. M., female, age 54, was admitted to Cedars of Lebanon Hospital April 1, 1951, with a history of progressive weakness and fatigability without abdominal pain, nausea, vomiting, or icterus. For the past week the stools had been black. On admission the red blood count was 3,920,000 and hemoglobin was 65 per cent.

Gastrointestinal study on April 7, 1951 (Fig. 1), showed a marked localized expansion in the periampullary portion of the duodenum, involving an area measuring about 6 cm. in length and 3.5 cm. in width. The mucosal folds were markedly widened and distorted, with a centrally located ulcer crater measuring 2 cm. horizontally and 0.5 cm. vertically. The diagnosis of ulcerative tumor of the duodenum, either benign or malignant, was made.

Laparotomy revealed a mass in the second portion of the duodenum, mainly on the anterior wall. On opening the duodenum the tumor was found to lie at the level of the ampulla of Vater. A side excision was carried out. The surgical specimen (Fig. 2,) consisted of a firm, pink polypoid lesion, measuring $4 \times 4 \times 1.2$ cm., surrounded on all sides by a cuff of apparently normal duodenum. The serosa was puckered. The surface of the tumor was superficially ulcerated. The microscopic diagnosis was adenocarcinoma.

CASE II: E. G., female, age 47, was admitted April 19, 1954, with a history of right upper abdominal pain for several months before admission, which had gradually become more severe, occasionally awakening her at night. It was not related to intake of food. There was no history of vomiting or "tarry" stools. There had been a loss of about 10 lb. of weight since the onset of the illness.

Gastrointestinal study on April 12, 1954 (prior to admission), showed an expanding lesion in the second portion of the duodenum, with marked distortion and destruction of the mucosa and a 1.5-cm. ulcer crater on the medial duodenal wall. The widened mucosal folds were seen to converge toward the crater. The lesion measured 6 cm. in length (Fig. 3). The radiological diagnosis was ulcerative carcinoma or lymphosarcoma of the duodenum.

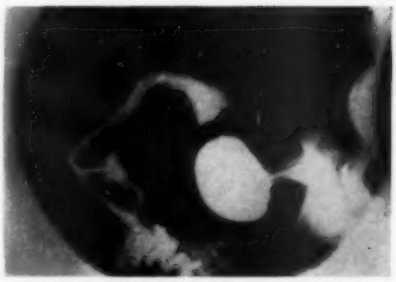


Fig. 3. Case II. Ulcerative periampullary carcinoma of the medial wall of the duodenum with markedly thickened mucosal folds converging toward the crater.

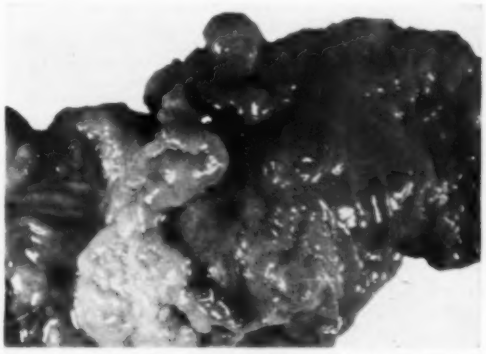


Fig. 4. Case II. Mucosal folds raised and rolled around the malignant ulcer crater.

Exploration revealed a palpable mass in the second portion of the duodenum with an underlying thickening of the pancreas. A Whipple operation was carried out. The surgical specimen (Fig. 4) consisted of the distal end of the stomach, the duodenum, and a portion of the head of the pancreas. Five centimeters from the pyloric ring was a tumor measuring $5.5 \times 3.5 \times 1.5$ cm., almost completely encircling the duodenum. The edges were rolled, raised, gray-red, and smooth. There was a central ulcer measuring 1.5×0.8 cm. The ampulla of Vater was located 0.3 cm. from the distal border of the tumor. The microscopic diagnosis was adenocarcinoma of the duodenum.

CASE III: M. S., male, age 65, was admitted to Cedars of Lebanon Hospital on Sept. 2, 1952, with a history of jaundice, constipation, weight loss, and black stools of three months duration.

The patient was too ill to be studied radiologically and was operated upon on Sept. 12, 1952. A tumor was found in the second portion of the duodenum and a Whipple resection was carried out.

The surgical specimen (Fig. 5) consisted of the distal end of the stomach and 22 cm. of the duodenum. Nine centimeters distal to the pylorus was a hard napkin-ring tumor, measuring 6×4 cm. and

Fig. 5. Case III. Surgical specimen (Whipple resection), showing a carcinoma in the periampullary portion of the duodenum with a 3-cm. area of ulceration. The probe is in the dilated pancreatic duct, its upper end extending into the ulcer.

Gastrointestinal study on May 26, 1948 (Fig. 6), showed the first and second portions of the duodenum to be markedly dilated, with large polypoid intraluminal filling defects. The second portion of the duodenum was irregular in contour. An x-ray diagnosis of polypoid neoplasm of the first and second portions of the duodenum was made.

At operation, June 1, 1948, the duodenum was found to be dilated to four times its normal size and to contain a tumor, which was irregular in shape. There were numerous elevated nodules in the liver, measuring 1 to 3 cm. in diameter. Only a liver biopsy was done, as the lesion appeared inoperable. The microscopic diagnosis was metastatic carcinoma.

CASE V (Courtesy of Dr. Kurt H. Kent): D. L., female, age 77, was admitted to St. Francis Hospital on Dec. 13, 1948, with a history of anorexia and frequent vomiting during the preceding eight months. There was no hematemesis or tarry stools.

Roentgen studies of the intestinal tract on Dec. 13, 1948 (Fig. 7), showed a constricting lesion meas-

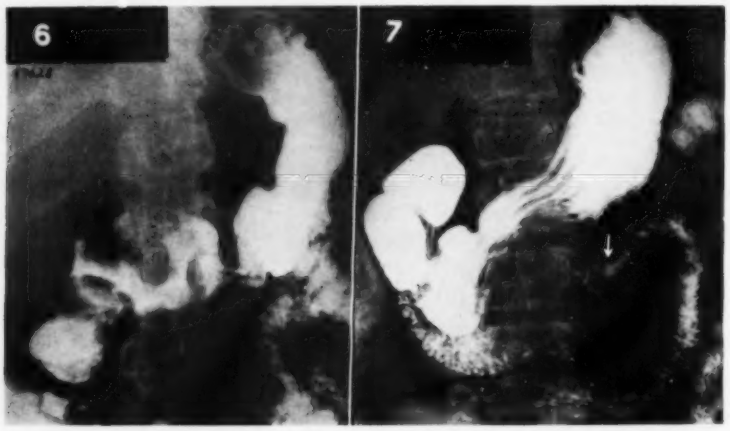


Fig. 6. Case IV. The entire first and second portions of the duodenum are dilated and contain filling defects of various sizes and shapes. At operation an inoperable carcinoma of the duodenum was found.

Fig. 7. Case V. Scirrhous type of adenocarcinoma producing a napkin-ring deformity at the duodenojejunal junction (arrow).

completely encircling the duodenum. In the center of this mass was a 3-cm. ulcer crater. The ampulla of Vater was completely enveloped by the tumor and the common duct was markedly dilated, measuring 3 cm. in diameter. The microscopic diagnosis was adenocarcinoma of the duodenum with metastases in the lymph nodes.

CASE IV (Courtesy of Dr. Kurt H. Kent): K. J., female, age 70, was admitted to St. Francis Hospital on May 25, 1948, complaining of epigastric distress of three years duration. She had experienced intermittent diarrhea for five years and a sense of fullness in the upper abdomen for two months. Recently she had passed occasional black stools.

uring 2 cm. in length and 3 mm. in width at the duodenojejunal junction. The mucosal membrane pattern was completely destroyed in the area of narrowing.

The patient was operated upon on Dec. 16. Beginning just proximal to the ligament of Treitz, extending beneath and slightly distal, was an indurated annular lesion. The tumor was freely movable and the tumor-bearing area of the duodenum was resected. The microscopic diagnosis was adenocarcinoma of the duodenum with stenosis and ulceration.

The following 2 cases demonstrate the occasional impossibility of differentiat-

ing between a primary carcinoma of the duodenum, a primary carcinoma of the pancreas invading and ulcerating the duodenum, and a benign ulcer in the second portion of the duodenum.

CASE VI: F. S., female, age 47, was admitted to Cedars of Lebanon Hospital on Nov. 1, 1954, com-

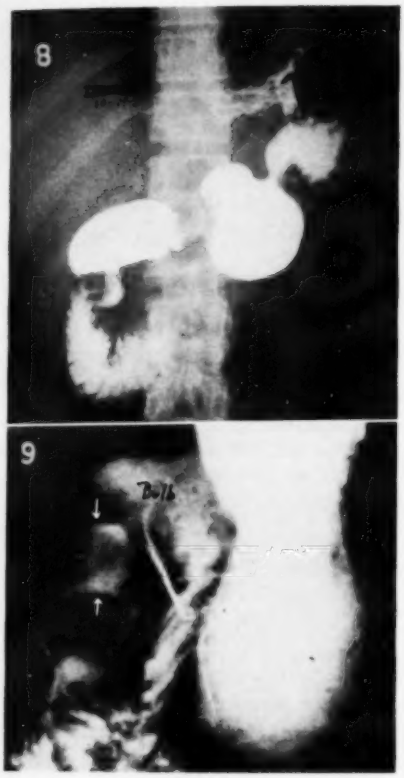


Fig. 8. Case VI. Examination on Oct. 19, 1954, showing an eccentric ulcer crater in the upper part of the second portion of the duodenum, with narrowing of the lumen and slight dilatation of the first part of the duodenum, but not of the stomach.

Fig. 9. Case VI. Re-examination thirteen days later, showing the stomach and duodenum proximal to the ulcer to be markedly dilated and to contain fluid and food remnants. Ulcer crater has increased in size.

plaining of dull pain in the interscapular area of six weeks duration. The pain was not related to meals and was relieved by aspirin. Three weeks before admission attacks of vomiting began to occur, associated with several bouts of hematemesis.

A roentgen study at another hospital, Oct. 19, 1954 (Fig. 8), showed an ulcer crater at the junction of the first and second portions of the duodenum measuring 2.0 × 1.0 cm., with some narrowing of the duodenal lumen. The duodenum proximal to the

Fig. 10. Case VI. Ulcer crater on the posterior wall of the duodenum from a pancreatic tumor penetrating into the duodenum.

lesion was moderately dilated, but there was no impairment of the gastric emptying function.

The second examination, Nov. 2, 1954 (Fig. 9), showed the size of the ulcer crater as well as the narrowing of the duodenum to have increased. There was no widening of the duodenal sweep. The stomach and duodenal bulb were dilated and contained retained food particles; marked impairment of gastric emptying had developed. A radiologic diagnosis of probable ulcerative carcinoma of the duodenum was made.

The patient continued having gastric hemorrhages and, despite repeated blood transfusions, her red blood count went down to 3,100,000, with hemoglobin 60 per cent.

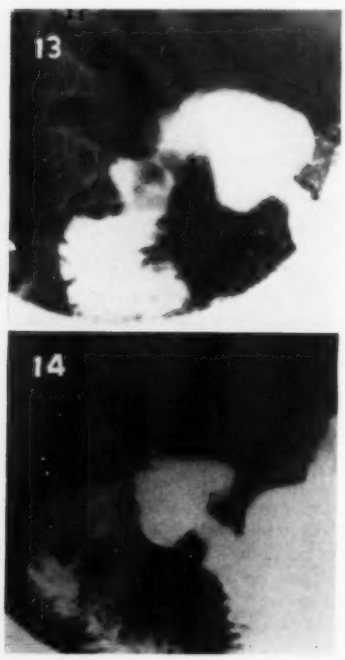
At operation, Nov. 4, a large palpable mass was found in the second portion of the duodenum. A Whipple operation was carried out.

The surgical specimen (Fig. 10) showed a 2.5 × 1.5-cm. ulcer crater on the posterior wall of the duodenum, 6 cm. distal to the pylorus, having a gray-red cobblestone base, sharply defined borders, and peripherally rolled mucosal folds radiating out in a spoke-like fashion. The lesion was connected with a rock-hard pancreatic mass, 5 × 4 × 2 cm., which appeared to consist entirely of infiltrating strands of gray-white tumor.

The microscopic diagnosis was adenocarcinoma of the pancreas and carcinomatous ulcer of the duodenum.

CASE VII: H. C., male, age 45, was admitted to Cedars of Lebanon Hospital on May 1, 1954, with a history of lower chest and epigastric distress of ten months duration. About three months before admission, boring epigastric pain had developed, at first not related to food intake, subsequently with some tendency to occur before and after the evening meal. There was no occult blood in the stools. Roentgen examination of the gastrointestinal tract

Fig. 11. Case VII. Annular constriction of the upper part of the second portion of the duodenum, with a long, vertical ulcer crater on the medial wall.
Fig. 12. Case VII. Photograph of the excised duodenum and ulcer (Whipple resection). Microscopically, the lesion proved to be a benign duodenal ulcer.



Figs. 13 and 14. Benign postbulbar ulcer with marked swelling of the surrounding mucosa, imitating the radiological appearance of carcinoma. The last examination (Fig. 14), eight months after the earlier one, shows the ulcer to have disappeared and only some widening of the mucosal folds to remain at its site.

on the day of admission (Fig. 11) showed gross annular constriction of the proximal half of the second portion of the duodenum. On the medial aspect of the deformity was an ulcer crater measuring 2.5 × 0.5 cm. The mucosa in the involved area was distorted, and no peristalsis was seen to pass through it. The diagnosis was either ulcerative carcinoma or benign postbulbar ulcer with chronic scar deformity.

The patient was operated upon on May 7. The head of the pancreas was stony hard and there was considerable edema in the tissues immediately surrounding the first and second portions of the duodenum. A Whipple resection was carried out.

The surgical specimen (Fig. 12) showed an oval ulcer crater, measuring 2.0 × 1.0 cm., on the anterior wall of the duodenum, 4.5 cm. distal to the pylorus. The edges sloped obliquely to form an indurated base, which was adherent to the pancreas. The microscopic diagnosis was benign duodenal ulcer surrounded by inflammatory tissue reaction.

Figure 13 shows another benign postbulbar ulcer surrounded by swelling of the mucosal membrane and deformity of the duodenum in the region of the crater, resembling radiologically an ulcerative carcinoma of the duodenum. The patient was placed on an ulcer regime, and subsequent roentgen studies showed a gradual decrease in the size of the lesion. The last examination, eight months later (Fig. 14), showed complete healing of the ulcer and disappearance of the duodenal deformity. Only a few slightly widened mucosal folds remained at the site.

Figures 15 and 16 show typical roentgen findings in 2 cases of proved carcinoma of the head of the pancreas. The duodenal sweep is widened, and there is a deformity of the entire medial wall of the duodenum, with slight irregularities of the contour in

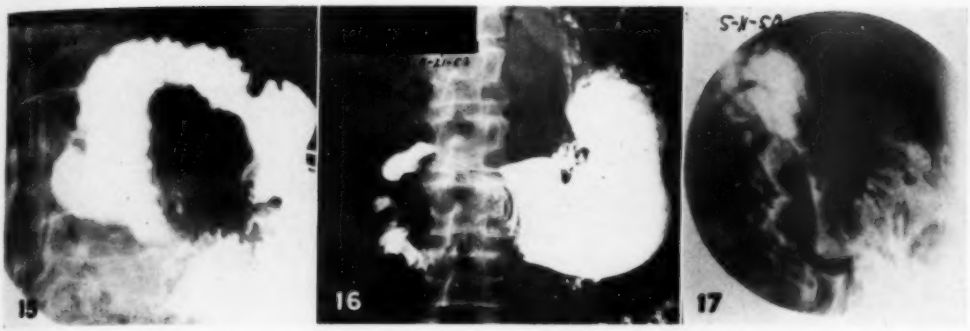


Fig. 15. Carcinoma of the head of the pancreas producing enlargement of the duodenal sweep and pressure deformity on the medial wall of the entire duodenum.

Fig. 16. Carcinoma of the head of the pancreas with a widened sweep and pressure deformity of the duodenum as well as of the pyloric end of the stomach.

Fig. 17. Frostberg's reversed "figure of 3" sign on the medial wall of the periampullary portion of the duodenum, produced by a proved carcinoma of the ampulla of Vater.

Figure 15 (proved at autopsy) and an additional pressure deformity of the greater curvature side of the pyloric portion of the stomach in Figure 16 (proved by surgery).

Figure 17 presents the Frostberg inverted "figure-of-3" sign in a proved case of primary carcinoma of the ampulla of Vater, a finding occasionally obtained also in carcinoma of the head of the pancreas.

Benign tumors of the duodenum are usually easier to differentiate from carcinoma or benign ulcer. They present rather sharply defined filling defects without destruction of the covering mucosa. There may be widening and flattening of the rugae, but mucosal ulceration is rare. If, however, these tumors attain a large size, partially or fully obstructing the lumen of the duodenum, they may be difficult to differentiate from a malignant neoplasm.

Occasionally a small mass in the head of the pancreas may, by extrinsic pressure, simulate a benign intrinsic tumor with an "intraluminal" defect in the second portion of the duodenum.

The following cases illustrate the radiological findings in benign duodenal tumors.

CASE VIII: W. D., male, age 36, was admitted to Cedars of Lebanon Hospital on Dec. 16, 1953. On the day before admission he felt weak but continued work at his office. Later, at 6:00 P.M., he had several black bowel movements. He had had similar attacks of melena four years earlier, and a gastrointestinal study elsewhere was then reported as negative. During the interim the patient was quite well. On admission, the red blood count was 3,400,000 and hemoglobin 54 per cent.

Gastrointestinal study on Dec. 24 (Fig. 18) showed a sharply defined lobulated filling defect along the lateral border of the second portion of the duodenum, measuring about 2.5 cm. in diameter. A central ulcer crater measured 1.5 cm. in length and about 0.8 cm. in width. Except for the area of ulceration, the mucosa over the filling defect was neither deformed nor destroyed. A diagnosis of benign extramucosal and intramural tumor, probably leiomyoma, of the second portion of the duodenum was made. Review of the films taken four years earlier showed the duodenal defect to have been present at that time but evidently overlooked. It had not changed in size or configuration during the interval.

At operation, Dec. 28, a 2.5-cm. anterior wall tumor was found in the descending portion of the duodenum, extending partially into the lumen and partially outward from the duodenal wall. A local resection was carried out.

The surgical specimen (Fig. 19) consisted of a segment of the duodenum measuring 3.5 cm. in length. Within the muscularis was an ovoid mass, 1.5 cm. in diameter and 0.9 cm. in depth. The microscopic diagnosis was myoma with ulceration.

CASE IX: M. D., male, age 51, was admitted to Cedars of Lebanon Hospital on Nov. 12, 1951, giving a history of indefinite gastric discomfort for several years, occurring an hour to an hour and a half after meals, not associated with nausea, vomiting, or jaundice. During the past three months, the patient had lost 12 to 15 lb. of weight.

Radiological study on Aug. 27, 1951 (prior to admission) (Fig. 20), had revealed an intraluminal defect in the second portion of the duodenum without obstruction or mucosal destruction. The changes were thought to be due to pressure from an extrinsic tumor or to an intramural and extramucosal benign tumor.

Fig. 18. Case VIII. There is a rather sharply defined lobulated filling defect along the lateral aspect of the second portion of the duodenum, with a long ulcer crater. Mucosal folds are not altered in the region of the defect.

Fig. 19. Case VIII. Locally resected myoma of the duodenum with central ulceration.

Fig. 20. Case IX. Sharply defined intraluminal defect in the central part of the second portion of the duodenum. The microscopic examination of the resected specimen showed it to be a ganglioneuroma.

The patient was operated upon on Jan. 14, 1952. In the section portion of the duodenum, 2 cm. proximal to the ampulla, was a smooth mass measuring 0.5 × 2 cm. It was locally resected.

The gross specimen showed a mushroom-shaped nodule, measuring 1.7 × 1.3 × 0.7 cm., and covered with mucosa. The microscopic diagnosis was ganglioneuroma.

CASE X: V. F., female, age 47, was admitted to Cedars of Lebanon Hospital on Feb. 13, 1951, complaining of attacks of pain in the epigastrium lasting three to four days, occurring on and off during the past two years. The pain was not relieved by food nor was it related to meals.

Gastrointestinal study (Fig. 21) on Jan. 10, 1951, had shown a cauliflower-like tumor with a pedicle in the duodenal bulb, measuring about 3.5 cm. in diameter. This was thought to be a gastric polyp which was herniated into the duodenal bulb.

At operation, Feb. 14, 1951, a pedunculated polyp was found on a long stalk in the duodenal bulb. The stalk did not originate in the stomach, but in the pyloric end of the duodenum. A longitudinal incision was made into the bulb and the polyp was resected at the base of its stalk.

The surgical specimen (Fig. 22) consisted of a pedunculated, lobulated adenomatous lesion, covered with mucosa, measuring 4 × 2.3 × 0.9 cm., attached to a 0.6-cm. stalk. The microscopic diagnosis was polypoid adenoma (Brunner glands) of the duodenum.

Figure 23 shows how extrinsic tumors pressing against the second portion of the duodenum may present a radiological appearance simulating a benign intramural and extramucosal tumor. At operation a small mass was found in the head of the pancreas pressing on but not adherent to the duodenum. The surgeon thought the mass to be a localized inflammatory lesion of the head of the pancreas, but no biopsy was obtained.

The Brunner glands of the duodenum may occasionally become abnormally prominent. If this occurs, the hypertrophied glands produce multiple small, round, sharply defined, intraluminal defects. Figures 24 and 25 demonstrate the radiological and macroscopic appearance of hypertrophied Brunner glands in the duodenum.

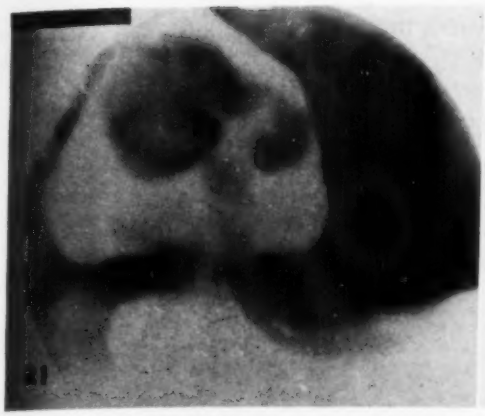


Fig. 21. Case X. Multilocular intraluminal filling defect in the duodenal bulb. Pedicle arising from the duodenal side of the pyloric canal.

Fig. 22. Case X. Resected lobulated tumor and its stalk. Histologically the tumor was a polypoid adenoma of the Brunner glands.

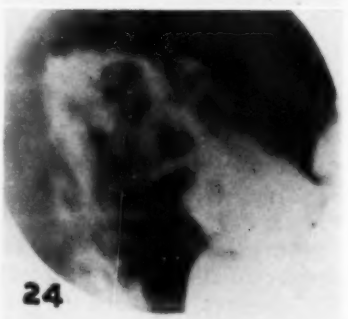


Fig. 23. Sharply defined 14-mm. intraluminal defect in the upper part of the second portion of the duodenum, thought to be due to an intramural and extramucosal benign tumor. At operation a small inflammatory mass was found in the head of the pancreas, pressing on but not adherent to the duodenum.

Fig. 24. Multiple small filling defects scattered throughout the entire first portion of the duodenum. Incidental finding encountered in a patient clinically suspected of having a carcinoma of the head of the pancreas.

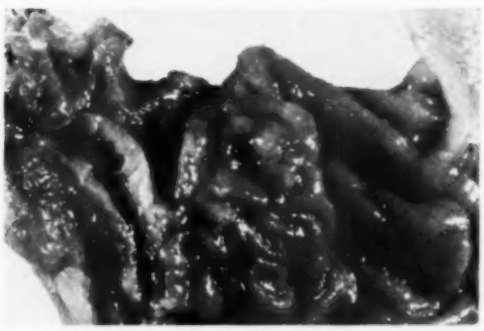


Fig. 25. Photograph of the first portion of the duodenum of the patient in Fig. 24. A Whipple resection was done for carcinoma of the head of the pancreas. Mucosal folds show marked thickening, and the microscopic diagnosis was hypertrophy of the Brunner glands.

Figure 26 shows another case considered to represent the same condition involving both the first and second portions of the duodenum, with multiple 4- to 6-mm. polypoid mucosal defects. This picture was unchanged over a period of five years.

SUMMARY

1. Neoplastic lesions of the duodenum are rare. Five cases of primary carcinoma and 3 cases of benign tumors, all proved surgically, are reported.

2. The radiological diagnosis of neoplasm of the duodenum is discussed and the occasional difficulties of differentiation from tumors of the pancreas, gallbladder, and ampulla of Vater, annular pancreas,

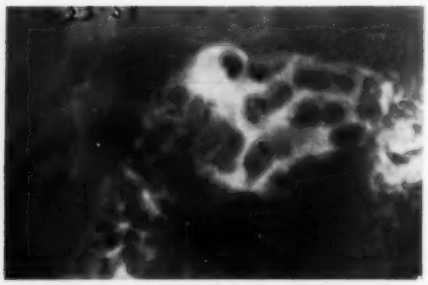


Fig. 26. First and second portions of the duodenum filled with small intraluminal defects thought to be due to hypertrophy of the Brunner glands. Condition remained unchanged on two x-ray examinations five years apart.

and benign postbulbar ulcers are pointed out.

3. Careful roentgen investigation of the entire duodenum, particularly the postbulbar portion, is necessary for early diagnosis of malignant and benign duodenal tumors.

Cedars of Lebanon Hospital
Los Angeles 29, Calif.

REFERENCES

1. KLEINERMAN, J., YARDUMIAN, K., AND TAMAKI, H. T.: Primary Carcinoma of the Duodenum. Ann. Int. Med. **32:** 451–465, March 1950.

2. SCHWARTZ, N. H., SWINGLE, R. C., AND RAYMOND. E. A.: Malignant Tumors of the Duodenum. Report of 2 Cases. Arch. Int. Med. **87:** 410–417, March 1951.

3. EGER, S. A.: Primary Malignant Disease of the Duodenum. Arch. Surg. **27:** 1087–1108, December 1933.

4. GOLDEN, R.: Non-malignant Tumors of the Duodenum. Report of 2 Cases. Am. J. Roentgenol. **20:** 405–413, November 1928.

5. RANKIN, F. W., AND NEWELL, C. E.: Benign Tumors of the Small Intestine. Report of 24 Cases. Surg., Gynec. & Obst. **57:** 501–507, October 1933.

6. HOFFMAN, B. P., AND GRAYZEL, D. M: Benign Tumors of Duodenum. Am. J. Surg. **70:** 394–400, December 1945.

7. HOFFMAN, W. J., AND PACK, G. T.: Cancer of the Duodenum. Clinical and Roentgenographic Studies of 18 Cases. Arch. Surg. **35:** 11–63, July 1937.

8. DIXON, C. F., LICHTMAN, A. L., WEBER, H. M., AND MCDONALD, J. R.: Malignant Lesions of the Duodenum. Surg., Gynec. & Obst. **83:** 83–93, July 1946.

9. DEWIS, J. W., AND MORSE, G. W.: Primary Adenocarcinoma of the Duodenum. Report of 12 Proved Cases. Summary of Literature. New England J. Med. **198:** 383–401, April 12, 1928.

10. BERGER, L., AND KOPPELMAN, H.: Primary Carcinoma of the Duodenum. Ann. Surg. **116:** 738–750, November 1942.

11. RAIFORD, T. S.: Tumors of the Small Intestine; Their Diagnosis with Special Reference to the X-Ray Appearance. Radiology **16:** 253–270, February 1931.

12. FROSTBERG, N.: Characteristic Duodenal Deformity in Cases of Different Kinds of Perivaterial Enlargement of the Pancreas. Acta. radiol. **19:** 164–173, 1938.

13. SHALLOW, T. A., WAGNER, F. B., JR., AND MANGES, W. B.: Primary Carcinoma of the Infrapapillary Portion of the Duodenum. Surgery **27:** 348–355, March 1950.

14. EBERT, R. E., PARKHURST, G. F., MELENDY, D. A., AND OSBORNE, M. P.: Primary Tumors of the Duodenum. Surg., Gynec. & Obst. **97:** 135–139, August 1953.

SUMARIO

Tumores Benignos y Malignos del Duodeno

Los tumores duodenales son raros. Por no ser el cuadro clínico distintivo, los estudios roentgenológicos ofrecen el medio más útil de diagnóstico, aunque tampoco son terminantes.

El típico tumor benigno produce un nicho regular bien definido dentro del duodeno lleno de bario. Tal vez haya dilatación de la pared duodenal y hasta ulceración, pero nunca franca destrucción de las superficies de las mucosas. La presencia de un pedículo milita en pro de un tumor benigno.

El carcinoma duodenal tiene su origen en la mucosa y la primera manifestación es una alteración irregular con desaparición subsiguiente del patrón normal de la mucosa. Más tarde, cuando ésta se desgasta, se forma un cráter irregular, alrededor del cual se espesa y fija la pared duodenal. Gradualmente, la lesión se extiende a la luz del duodeno, produciendo una estrechez asimétrica.

Las dolencias que hay que diferenciar de los tumores duodenales son las lesiones neoplásicas del páncreas, de la papila de Santorini, de la vesícula biliar y del colédoco, las metástasis neoplásicas en los linfáticos periduodenales, el páncreas anular y la ulceración postbulbar benigna crónica.

Preséntanse 5 casos de carcinoma primario del duodeno y 3 de tumores benignos, todos ellos comprobados quirúrgicamente. También se describen casos de úlcera postbulbar con invasiones secundarias del duodeno para demostrar las dificultades del diagnóstico.

Barium in Hydrogen Peroxide in Esophageal and Gastric Diagnosis[1]

CESARE GIANTURCO, M.D., and GEORGE A. MILLER, M.D.

RADIOLOGICAL diagnosis would be greatly facilitated by opaque materials capable of some reaction in contact with diseased tissues. In the gastrointestinal tract a medium capable of adhering for a few hours to areas without mucosal covering would make it possible to visualize the majority of lesions by examination of the patients after the passage of the opaque meal. Similar behavior could be expected from media capable of coating for a few hours pathologic areas which do not move with peristaltic activity. Such media are not easy to compound, but their diagnostic and therapeutic possibilities warrant systematic research in this field.

The credit for employing the first "pathology-sensitive" medium belongs to Paavo Klami, who in 1953 published a short report on his experience with barium suspended in hydrogen peroxide (H_2O_2). This suspension foams in contact with ulcerated surfaces and the foam may be detected by the roentgen rays (Fig. 1).

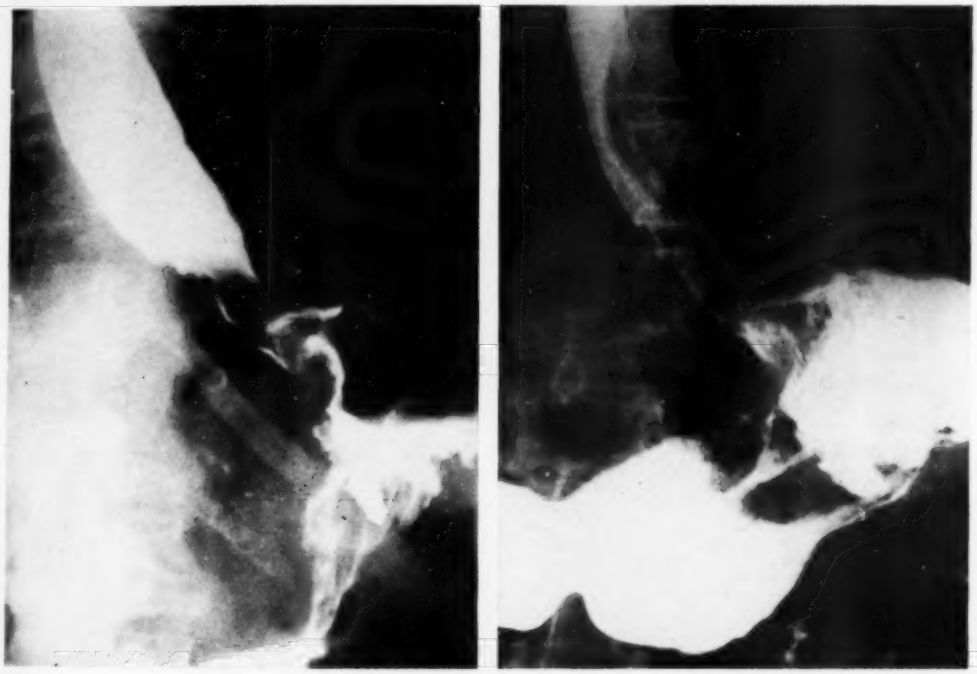


Fig. 1. Left: Carcinoma involving the lower esophagus and cardiac end of stomach as demonstrated by ordinary barium. Right: Same case after ingestion of barium in H_2O_2. Note mottling of the tumor area due to gas bubbles.

Our experience with barium in H_2O_2 includes 4 cases of gastric ulcer, 11 cases of duodenal ulcer, 1 case of regional ileitis, 1 case of lower esophageal carcinoma, 1 case of carcinoma of the stomach, 1 case of lymphosarcoma of the stomach, and 32 cases of suspected lesions of various types, which proved negative. Such experience is limited, but the following conclusions appear warranted:

[1] From the Carle Hospital Clinic, Urbana, Ill. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

1. Barium in H_2O_2 is not palatable and, if given in quantities greater than 2 oz., may cause nausea and vomiting. Perhaps the best way to use this medium is to begin the examination with 2 oz. of ordinary barium in water and then, if advisable, administer 2 oz. in H_2O_2. Thus diluted, barium in H_2O_2 is well tolerated.

2. Spot films disclose slight effervescence of barium in H_2O_2 in normal stomachs. This has no diagnostic significance.

3. Barium in H_2O_2 causes abundant foam in the presence of intragastric blood and pus, regardless of the origin of these materials (Fig. 2).

4. Bubbling of barium in H_2O_2, if it occurs, is seen within twenty to thirty seconds after ingestion. This bubbling is best detected fluoroscopically. To be diagnostically significant, it must be abundant.

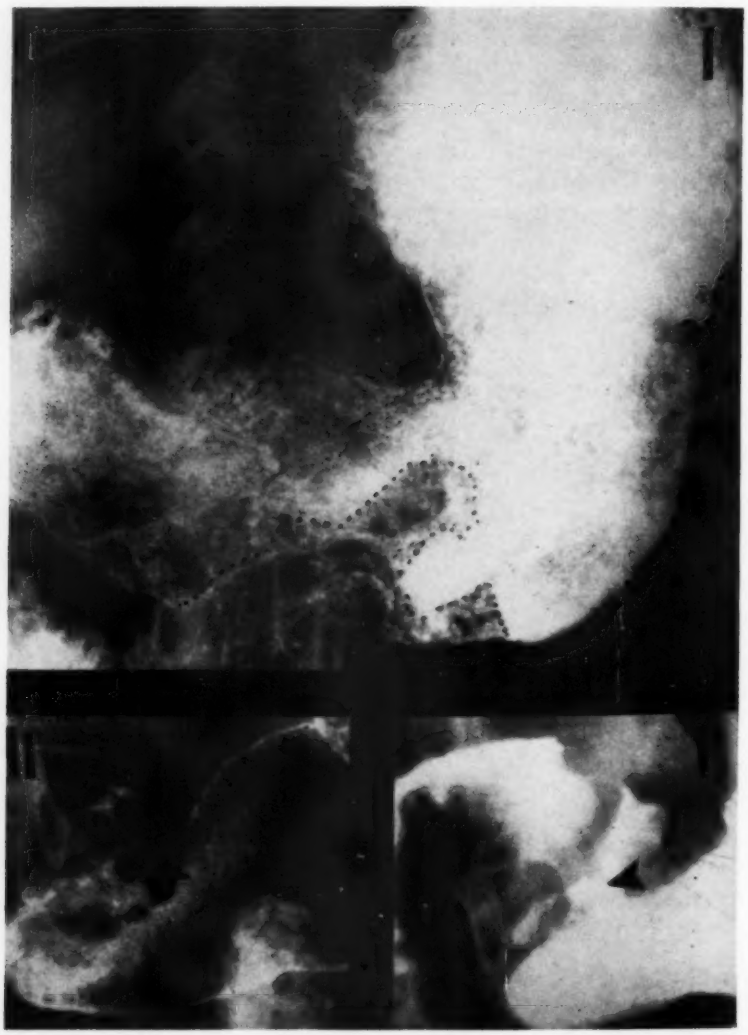


Fig. 2. Bubbling of barium in H_2O_2 due to blood in the stomach. I. Case of lymphosarcoma. II. Bleeding duodenal ulcer.

5. In the absence of free blood or pus,

barium in H_2O_2 will foam in quantities proportional to the size of the ulcerated surfaces. Because of their relatively small size, gastric and duodenal ulcers cause little foam. Foam in an ulcer crater displaces the barium and this may hinder instead of help the diagnosis.

6. In a case of regional ileitis involving scattered areas of the small bowel no bubbling occurred. It is probable that barium in H_2O_2 is of little value in small-intestinal diagnosis. Since H_2O_2 effervesces slowly in the normal stomach, it may reach the small bowel as ordinary water incapable of further bubbling.

7. Probably the best indication for the use of H_2O_2 is the clinical suspicion of ulcerations of the lower esophagus and of neoplasms of the cardiac portion of the stomach. These lesions are difficult to detect by ordinary examinations, and the bubbling of barium in H_2O_2 may show that a cardiospasm obscures a cancer of the cardia.

In summary, our experience indicates that barium in H_2O_2 is useful in a limited way. The importance of this new medium lies in the fact that it is the first "pathology-sensitive" opaque agent to be developed. We hope that future research will make available other opaque materials with a wider range of diagnostic usefulness.

ADDENDUM

Subsequent experience with barium in hydrogen peroxide has shown that food retained in a dilated esophagus causes bubbling of the mixture. This effervescence obvicusly has no significance in the differential diagnosis between cancer and cardiospasm.

Carle Hospital Clinic
Urbana, Ill.

REFERENCE

KLAMI, PAAVO: On the Visualization of Ulcerative Processes Using Hydrogen Peroxide in the Contrast Medium. A Preliminary Report. Acta radiol. **39:** 98–104 February 1953.

SUMARIO

Bario en Peróxido de Hidrógeno para el Diagnóstico Esofágico y Gástrico

El diagnóstico radiológico se facilitaría considerablemente con el uso de una substancia opaca susceptible de alguna reacción al ponerse en contacto con tejido patológico, es decir, un medio "patosensible." Para estudios gastrointestinales, Klami propuso en 1953 el empleo de una suspensión de bario en peróxido de hidrógeno, que espuma al entrar en contacto con una superficie ulcerada. Los AA. han usado esta preparación en una serie de 51 casos, resultándoles de valor limitado. La mejor indicación de la misma pareció ser en el examen de úlceras sospechosas de la porción inferior del esófago y de neoplasias del cardias, que es difícil descubrir con los medios ordinarios. El burbujeo del medio observable en la radiografía puede conducir al diagnóstico de un cáncer del cardias ocultado por cardiospasmo.

Meckel's Diverticulum

With Emphasis on the Roentgen Diagnosis[1]

MARTIN E. BISCHOFF, M.D.,[2] and WENDELL P. STAMPFLI, M.D.

THE PREOPERATIVE diagnosis of Meckel's diverticulum is seldom made. The first mention of the roentgen demonstration of this structure was by Case in 1926 (7), though Pfahler (30) is generally given credit for introducing the roentgenologic diagnosis in 1934. We have reviewed, from the literature, 33 cases in which a preoperative roentgen diagnosis was obtained. Thirty of these diagnoses were confirmed by operation or autopsy. The methods by which the diverticula were demonstrated are shown in Table I, which includes also the original references.

The barium sulfate meal followed by serial films of the small intestine was the procedure most successfully used. This method was employed in 20 cases. Lipiodol injection into an umbilical fistula, with a subsequent roentgenogram, led to the diagnosis in 1 instance. Seven cases were demonstrated by a barium sulfate enema. Lerner *et al.* (23) described an air-filled Meckel's diverticulum, confirmed by a barium enema. Basile and Elfersy (3) demonstrated an opaque calculus within the diverticulum on a plain film.

PATHOLOGY

The definition of Meckel's diverticulum requires that it project from the free border of the intestine, have a complete intestinal wall, be conical in shape, and have a wide mouth (23). This anomaly was first described and correctly interpreted by Meckel in 1812. Embryologically, it represents a partial persistence of the yolk stalk and the omphalomesenteric attachment (4, 12, 28). The diverticulum may retain a patent opening through the umbilicus, it may be joined to the umbilicus by a fibrous cord, or it may remain as a freely movable blind pouch of various dimensions (28). It arises from the distal ileum, 1 to 3 feet proximal to the ileocecal valve. In a large proportion of cases, aberrant tissue is present. Ectopic gastric tissue has been found in 16 per cent of all Meckel's diverticula, often accounting for hemorrhage (17, 18). Aberrant pancreatic tissue occurs in 3 to 4 per cent. Less commonly, duodenal or bile duct tissue is encountered (19).

Two per cent of autopsy subjects are said to have Meckel's diverticula, in a ratio of 3 males to 1 female (28).

CLINICAL FEATURES

The morbidity and clinical symptoms associated with Meckel's diverticulum are the result of complications, as hemorrhage, perforation, volvulus, intussusception, or intestinal obstruction. Symptoms and signs are more common in childhood and frequently mimic acute appendicitis. This is due to inflammation at the mouth of the diverticulum, with subsequent narrowing (8, 19, 29, 30). Less commonly there may be an umbilical discharge or formation of a cystic tumor. The diverticulum may be incarcerated in a hernia. Foreign bodies such as fish bones sometimes become lodged within a diverticulum and lead to perforation. Polyps, leiomyomas, sarcomas, carcinomas, and carcinoids have been reported as originating in Meckel's diverticula (8, 18, 19, 29).

ROENTGEN FINDINGS

The roentgen signs of this anomaly have received relatively little attention. Alvary (2) presented a classification based on the appearance of the barium-filled diverticulum, using such descriptive terms as "snake

[1] From the Department of Radiology, St. Luke's Hospital, Denver, Colo. Presented at the Mid-Summer Conference of the Rocky Mountain Radiological Society, Aug. 19–21, 1954. Accepted for publication in October 1954.

[2] Swedish Hospital Tumor Institute, Seattle, Wash. Now at St. Luke's Hospital, Denver.

TABLE I: MECKEL'S DIVERTICULA DIAGNOSED ROENTGENOLOGICALLY

Author	Year Reported	No. of Cases	Method of Diagnosis	Reproduction
Case (7)	1926	1	Barium meal. Proved	Ill-defined pouch with air-barium level. 1 Film
Soper (38)	1929	1	Barium meal. Proved	Ill-defined. 1 Film
Pfahler (30)	1934	2	Barium meal. One not proved	Excellent. 6 Films
Allemann (1)	1934	1	Barium meal. Proved	Ill-defined. 1 Film
Leveuf, Leroux, and Perrot (24)	1935	1	Lipiodol injection into umbilical fistula	Ill-defined. 1 Film
Prévôt (32)	1936	1	Barium enema	Good. 1 Film
Dixon, Deuterman, and Weber (11)	1938	3	Barium. Two proved	Ill-defined collection of barium. 1 Film
Ehrenpreis (12)	1939	1	Barium meal. Proved	Good. 3 Films
Skinner and Walters (36)	1939	1	Barium meal. Proved	Good. 2 Films
Conrad (9)	1941	1	Barium meal. Proved	Ill-defined. 1 Film
Ledoux (22)	1942	1	Barium meal. Proved	Good. 2 Films
Winkelstein (41)	1942	1	Barium meal. Proved	Ill-defined. 1 Film
Rousseau and Martin (35)	1943	1	Barium meal. Proved	Good. 1 Film
Carlson (6)	1944	1	Barium meal. Proved	Ill-defined. 1 Film
Poppel (31)	1944	1	Barium meal. Proved	Excellent. 1 Film
Tracey and Adams (39)	1944	1	Barium meal. Proved	Ill-defined. 1 Film
Mottram and Garland (27)	1945	1	Barium meal. Proved	Good. 3 Films
Hallendorf and Lovelace (17)	1947	1	Barium enema. Proved	None
Butler, Remington and Remington (4)	1950	1	Barium enema. Proved	Excellent. 2 Films
Raffensperger and Markunas (33)	1950	1	Demonstrated by barium meal. Proved. Not diagnosed preoperatively	Good. 2 Films
Elias and Ladin (13)	1950	1	Barium meal. Proved	Ill-defined gas-filled pouch. 1 Film
Grossman, Fishback, and Lovelace (16)	1950	1	Barium enema. Proved	Good. 4 Films
Alvary (2)	1951	1	Barium enema. Proved	Ill-defined. 3 Films
Basile and Elfersy (3)	1951	1	Calculus on plain film. Proved	Excellent. 2 Films
Caplan and Badner (5)	1952	1	Small bowel series. Proved	None
Mendelsohn (26)	1952	1	Barium meal and 6-hour film. Proved	Ill-defined. 1 Film
James (20)	1952	1	Barium enema. Proved	Excellent. 1 Film
Lerner, Levinson, and Kateman (23)	1953	1	Air-filled diverticulum and barium enema. Proved	Excellent. 2 Films
Lewitan (25)	1953	1	Barium meal with 4- and 6-hour films. Proved	Excellent. 7 Films
Sloan, Stafford, Singewald, and Sinn (37)	1954	2	Barium meal with 1- and 2-hour films. One proved Barium enema. One proved	Excellent. 6 Films

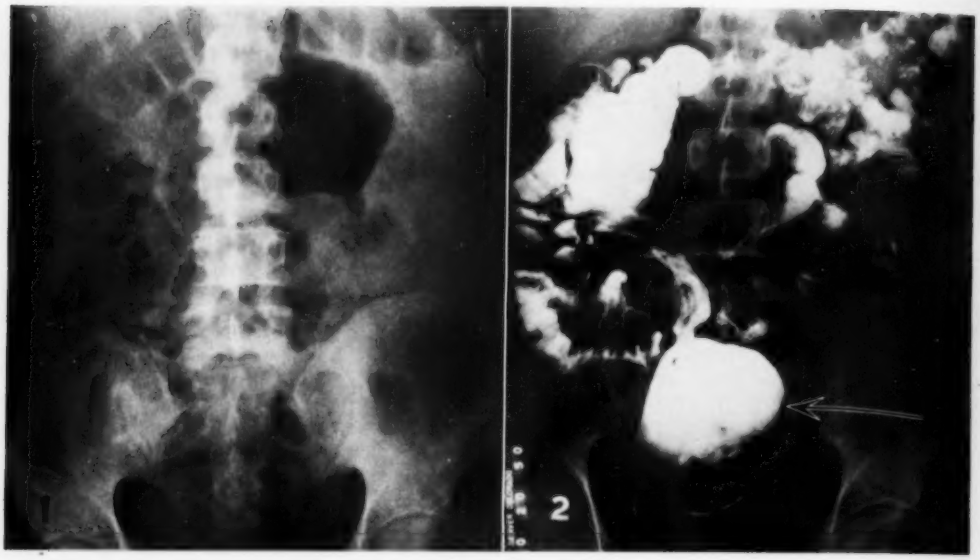
Total preoperative diagnoses, 33. Total proved, 30: barium sulfate meal, 20; barium sulfate enema, 7; Lipiodol injection, 1; air-filled diverticulum 1; calculus 1.

head," "pear head," and "bulbous," in combination with narrow or wide constrictions at the "neck." He stated that all types of Meckel's diverticula cause an angulation of the ileum at the site of insertion and that the diverticulum always hangs downward. Ehrenpreis (12) stressed the occurrence of persistent localized dilatation of a single loop of intestine "pointed" toward the umbilicus, which in his case was surrounded by an opaque dressing to orient its position during the examination. Definite peristalsis, a smooth outline, and a fixed position were considered characteristic by Pfahler. Lerner, Levinson, and Kateman (23) presented, as a new sign, demonstration of a gas-filled diverticulum on the survey roentgenogram of the abdomen. Basile and Elfersy, as mentioned above, made their diagnosis from an opaque calculus which lay within the pouch. This sign was first suggested by Gile and MacCarty (15), who recognized the calculi in retrospect. We wish to re-emphasize the presence of a calculus in the gas-filled pocket as a significant roentgen finding.

CASE REPORTS

CASE I[3]: A 27-year-old dairyman was admitted to Saint Luke's Hospital (Denver) on Sept. 29, 1950,

[3] The surgical features of this case have been reported by Dr. MacDonald Wood (42).



Figs. 1 and 2. Case 1. Fig. 1 shows the large gas-filled diverticulum high in the abdomen. A calcific shadow overlies the transverse process. In Fig. 2 the diverticulum, filled with barium and air, is seen low in the abdomen, arising from the ileum.

complaining of intense midabdominal pain, developing suddenly twenty-four hours previously and radiating to both shoulders. The pain had lessened in intensity, but nausea and emesis of clear fluid occurred twice.

The abdomen was flat and soft, with midabdominal tenderness, and bowel sounds were present.

The white blood cell count on admission was 17,550, with 84 per cent polymorphonuclear cells. Six hours later it was normal. A single roentgenogram of the abdomen in the supine position demonstrated a large spherical collection of gas in the upper abdomen to the left of the mid-line (Fig. 1). Partial small bowel obstruction was suspected. The patient was treated conservatively and discharged free of symptoms five days after admission.

He was re-admitted two weeks later because of four large bloody bowel movements with associated weakness. Again the abdomen was soft and flat. The rectum was full of clotted dark red blood mixed with feces. The red blood cell count was 4,360,000; hemoglobin 13 gm. The white cell count was 6,550 with 66 per cent polymorphonuclears. A barium enema study showed the colon to be normal. An upper gastrointestinal examination, with serial films of the abdomen over a twenty-four hour period, revealed a large smooth diverticulum arising from the distal portion of the small intestine. The diverticulum measured 11 cm. in diameter and was filled with barium and gas (Fig. 2). Review of the plain film of the abdomen (Fig. 1) showed a large movable bubble of gas, within which a calculus shaped like a folded ribbon could be seen faintly. The preoperative diagnosis was Meckel's diverticulum.

Operation disclosed a diverticulum arising from the antimesenteric border of the ileum, 2 1/2 feet from the ileocecal valve. It contained a deeply pigmented black stone of unusual shape, suggesting a ribbon folded several times. The pathologist[4] reported a bleeding Meckel's diverticulum. The patient was discharged asymptomatic and has remained free of abdominal complaints.

CASE II[5]: A white adult male had been seen frequently for several years, with vague complaints of gastrointestinal distress, gas, burning, and colicky pains. These symptoms were always localized to the midabdomen. The stools had never contained blood. Physical examination was always negative. Sedatives and antispasmodics produced prompt relief of symptoms.

During the patient's most recent experience of abdominal complaints, roentgen examinations were undertaken. A preliminary film of the abdomen revealed a foreign body of calcific density inside a bubble of gas (Fig. 3). On a lateral film this calcific shadow lay anterior to the brim of the pelvis (Fig. 4). A barium enema study showed it to be outside of the colon (Fig. 5). A calculus within a Meckel's diverticulum was the preoperative diagnosis.

At operation, a hemorrhagic saccular structure

[4] Dr. William C. Black, Saint Luke's Hospital, Denver, Colo.

[5] From Dr. James S. Haley, Longmont Hospital and Clinic, Inc., Longmont, Colo.

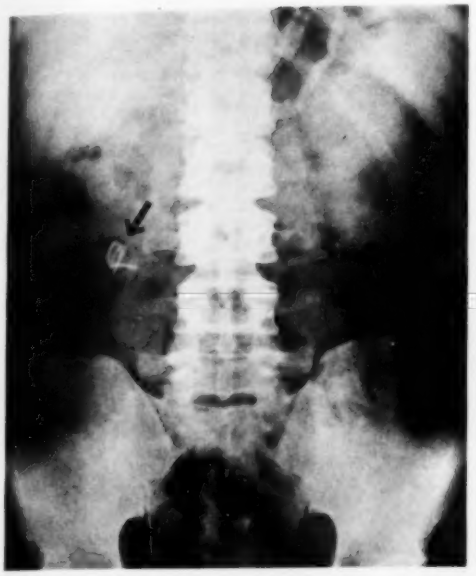


Fig. 3. Case II. Ribbon-like calcific shadow within a bubble of gas.

measuring 4 cm. in diameter, containing two hard concretions, was removed. The mass was centrally cystic and contained inspissated calcific material. The diagnosis was Meckel's diverticulum with chronic inflammation and heterotopic pancreatic tissue. The patient recovered, and his complaints have been less frequent.

DISCUSSION

The difficulty in diagnosing Meckel's diverticula is evidenced by the few cases reported. We believe that there are helpful roentgen signs which, when borne in mind, should enable radiologists to make the diagnosis more frequently. Most often discussed is the barium-filled diverticulum following a barium meal. The numerous coils of small intestine which normally lie in the pelvis usually obscure this sign, however. In our own experience with several thousand patients examined during the past eight years, three-hour films of the abdomen following barium by mouth revealed the diverticulum only once. Since 2 per cent of patients have the anomaly, it seems that we should be recognizing it more often.

In both of our cases we were able to demonstrate the sign mentioned by Lerner and his associates, namely, a gas-filled diverticulum, apparent on a plain film (Figs. 1 and 2). The presence of a calculus, occasionally of characteristic shape, is a third sign which we believe to be significant. In each of our cases the calculus cast a folded-ribbon-like shadow. This is best seen in Figure 3, but close scrutiny of Figure 1 also shows calcific material within the gas bubble.

Fig. 4. Case II. Lateral view of ribbon-like shadow seen in Fig. 3.

Fig. 5. Case II. Barium enema study, showing the shadow outside of the colon.

SUMMARY

1. The literature concerning the embryology, pathology, clinical significance, and preoperative diagnosis of Meckel's diverticulum has been reviewed.

2. Two cases of Meckel's diverticulum in which a preoperative roentgen diagnosis was made are reported.

3. The barium sulfate meal followed by serial films of the abdomen is the most successful method of examination.

4. Useful roentgen signs are the barium-filled diverticulum, the gas-filled diverticulum, and an opaque calculus lying within a bubble of gas.

5. We suggest that a folded-ribbon-like shadow, representing the calculus within the gas bubble, may be characteristic.

St. Luke's Hospital
Denver, Colo.

BIBLIOGRAPHY

1. ALLEMANN, R.: Zur Diagnose und Therapie des chronisch-intermittierenden subtotalen Ileus. Schweiz. med. Wchnschr. **64:** 331–333, April 14, 1934.

2. ALVARY, G.: Preoperative Diagnosis of Meckel's Diverticulum. U. S. Armed Forces M. J. **2:** 1459–1463, October 1951.

3. BASILE, A. R., AND ELFERSY, M.: Lithiasis of Meckel's Diverticulum. Report of a Case. Gastroenterology **18:** 287–289, June 1951.

4. BUTLER, G. V., REMINGTON, A. C., AND REMINGTON, J. H.: Preoperative Demonstration of Meckel's Diverticulum. M. Radiog. & Photog. **26:** 122–124, 1950.

5. CAPLAN, M., AND BADNER, D. H.: X-ray Demonstration of a Meckel's Diverticulum. Rev. Gastroenterol. **19:** 873–880, November 1952.

6. CARLSON, G. D.: Meckel's Diverticulum: Preoperative Roentgen Diagnosis. Mil. Surgeon. **95:** 272–274, October 1944.

7. CASE, J. T.: Jejuno-ileal Diverticula. Acta radiol. **6:** 230–240, 1926.

8. CAYLOR, H. D.: Meckel's Diverticulum. Gastroenterology **13:** 31–46, July 1949.

9. CONRAD, H. A.: Meckel's Diverticulum. Report of 2 Cases. Am. J. Surg. **52:** 267–274, May 1941.

10. DIMITROFF AND PURKISS: Guthrie Clinic Bull. **2:** No. 2, 1932.

11. DIXON, C. F., DEUTERMAN, J. L., AND WEBER, H. M.: Diverticula of the Intestine. Surg., Gynec. & Obst. **66:** 314–321, February (No. 2A) 1938.

12. EHRENPREIS, B.: Roentgen Diagnosis of Meckel's Diverticulum. Am. J. Roentgenol. **42:** 280–284, August 1939.

13. ELIAS, M. G., AND LADIN, P.: Roentgenological Diagnosis of a Meckel's Diverticulum. Am. J. Digest. Dis. **17:** 48–50, February 1950.

14. FOUCAULT: À propos de la radiographie du diverticule de Meckel. Mém. Acad. chir. **64:** 313–318, Feb. 23, 1938; Rev. méd. du centre-ouest **10:** 186–191, July 1938.

15. GILE, J. F., AND MACCARTY, W. C., JR: Calcified Concretions within a Meckel's Diverticulum. Radiology **41:** 491–494, November 1943.

16. GROSSMAN, J. W., FISHBACK, C. F., AND LOVELACE, W. R., II: Hemorrhage from a Meckel's Diverticulum as a Cause of Melena in Infancy. Report of a Case in Which the Diverticulum Was Demonstrated Roentgenologically. Radiology **55:** 240–243, August 1950.

17. HALLENDORF, L. C., AND LOVELACE, W. R., II: Aberrant Gastric Mucosa and Pancreatic Tissue in a Bleeding Meckel's Diverticulum: Report of a Case. Proc. Staff Meet., Mayo Clin. **22:** 53–55, Feb. 5, 1947.

18. HARTE, M. S., AND ELIAS, M. G.: Meckel's Diverticulum. Intussusception. Peritoneoscopy, Operative Cure. Am. J. Digest. Dis. **17:** 82–85, March 1950.

19. HAYNES, L. L., AND CRONEMILLER, P. D.: Complications of Meckel's Diverticulum. U. S. Armed Forces M. J. **1:** 1329–1335, 1950.

20. JAMES, T.: Radiological Visualization of a Meckel's Diverticulum. Brit. J. Radiol. **25:** 221–222, April 1952.

21. JUTRAS, A., AND ST. ONGE: Le diverticule de Meckel; revue clinique et radiologique à propos de trois observations. J. de l'Hôtel-Dieu de Montréal **9:** 313–337, November 1940.

22. LEDOUX, A. C.: Meckel's Diverticulum. Radiology **38:** 728–729, June 1942.

23. LERNER, H. H., LEVINSON, S. S., AND KATEMAN, A. E.: Meckel's Diverticulum: A New Roentgen Diagnostic Sign and Case Report. Am. J. Roentgenol. **69:** 268–271, February 1953.

24. LEVEUF, J., LEROUX, R., AND PERROT, A.: Trois cas de persistance du canal omphalo-mesentérique (fistule ombilicale congénitale). Ann. d'anat. path. **12:** 1015–1029, December 1935.

25. LEWITAN, A.: Roentgenologic Study of Meckel's Diverticulum. Case Report. Radiology **61:** 796–800, November 1953.

26. MENDELSOHN, E. A.: Complications of Gastrointestinal Diverticula Demonstrated by X-ray. Gastroenterology **20:** 105–118, January 1952.

27. MOTTRAM, M. E., and GARLAND, L. H.: Meckel's Diverticulum. Am. J. Roentgenol. **53:** 142–146, February 1945.

28. PATTEN, B. M.: Human Embryology. Philadelphia, The Blakiston Co., 1946.

29. PENBERTHY, G. C., AND BENSON, C. D.: Complications of Meckel's Diverticulum in Infants and Children. S. Clin. North America **28:** 1221–1231, October 1948.

30. PFAHLER, G. E.: Roentgenological Diagnosis of Meckel's Diverticulum. Surg., Gynec. & Obst. **59:** 929–934, December 1934.

31. POPPEL, M. H.: Roentgen Demonstration of Meckel's Diverticulum. Am. J. Roentgenol. **51:** 205–206, February 1944.

32. PRÉVÔT, R.: Meckelsches Divertikel im Röntgenbild. Röntgenpraxis **8:** 397, June 1936.

33. RAFFENSPERGER, E. C., AND MARKUNAS, F. B.: Roentgenologic Demonstration of a Meckel's Diverticulum. Gastroenterology **16:** 609–611, November 1950.

34. ROBINSON, W. W.: Meckel's Diverticulum: Its Demonstration by Continuous Barium-Stream. Memphis M. J. **19:** 8–9, January 1944.

35. ROUSSEAU, J. P., AND MARTIN, A. G. M., III: Meckel's Diverticulum: Preoperative Roentgen Diagnosis. Radiology **40:** 605–607, June 1943.

36. SKINNER, I. C., AND WALTERS, W.: Leiomyosarcoma of Meckel's Diverticulum, with Roentgenologic Demonstration of Diverticulum. Report of a Case. Proc. Staff Meet., Mayo Clin. **14:** 102–107, Feb. 15, 1939.

37. SLOAN, R. D., STAFFORD, E. S., SINGEWALD, M. L., AND SINN, C. M.: Meckel's Diverticulum. Am. J. Roentgenol. **71:** 64–75, January 1954.

38. SOPER, H. W.: Roentgen-Ray Diagnosis of Lesions of the Small Intestine. Am. J. Roentgenol. **22:** 107–119, August 1929.
39. TRACEY, M. L., AND ADAMS, R.: Meckel's Diverticulum Demonstrated by Roentgenogram: Report of a Case with Hemorrhage. Lahey Clin. Bull. **4:** 23–26, July 1944.
40. VOLUTER, G., AND THEVENOZ, F.: Contribution à l'étude radiologique du diverticule de Meckel. Praxis **36:** 789–792, Nov. 20, 1947.
41. WINKELSTEIN, A.: Ulcer in Meckel's Diverticulum: Unusual Roentgenologic Findings. Case Report. J. Mt. Sinai Hosp. **8:** 1118–1120, January–February 1942.
42. WOOD, M.: Meckel's Diverticulum. Rocky Mountain M. J. **49:** 1039–1045, December 1952.

SUMARIO

El Divertículo de Meckel con Hincapié en el Diagnóstico Roentgenológico

Repásase la literatura relativa al divertículo de Meckel, con referencia particular al diagnóstico roentgenológico. Se tabulan 33 casos en que se hizo un diagnóstico preoperatorio (confirmado en 30).

El diagnóstico se hace más comúnmente a base de radiografías seriadas del intestino delgado después de una comida de bario, que muestran esta substancia llenando el divertículo. Se han descubierto algunos casos con un estudio con enema de bario. La inyección de Lipiodol en una fístula umbilical, con una radiografía después, condujo al diagnóstico en 1 caso; en 2 se observó un divertículo lleno de gas en una radiografía corriente y en 1 se descubrió un cálculo opaco.

Preséntanse 2 casos nuevos, en los que se observaron en una radiografía corriente divertículos llenos de gas que contenían cálculos. En ambos casos, el cálculo tenía la forma de una cinta plegada, y parece que esto es típico. Ambos fueron comprobados quirúrgicamente.

The Application of Silicones to Roentgenology of the Colon

A Pilot Study[1]

THEODORE E. KEATS, M.D., and ROBERT M. WHITROCK, M.D.

THE GROWING importance of silicones in industry has stimulated investigation into the possible medical applications of these versatile substances. This report is concerned with an attempt to utilize liquid methyl silicone[2] as an agent to improve the mucosal detail in roentgen visualization of the colon.

The silicones have several interesting and important physical characteristics. They are insoluble in water and alcohol, resistant to oxidation and chemical agents, and able to withstand high temperatures. They are neutral in reaction and generally non-volatile and non-crystalline. They are good dielectrics, and have been shown to be inert to and not attacked by micro-organisms (1).

Previous experimental work revealed an adherence of emulsified combinations of thrombin and silicone to glass tubes and stomach mucosa (2). This adherence of the silicones and their lack of toxicity (1, 3) make them of particular interest to the roentgenologist and suggest that a similar combination of barium and silicone might produce an improved medium for roentgen visualization of the colon.

METHODS AND RESULTS

Suspensions of barium, water, and silicone were tested in a series of dilution experiments. One part of barium sulfate was mixed with two parts of a water-silicone diluent. With this combination, a serial dilution was carried out, in which the diluent was varied in silicone concentration from 0 to 100 per cent. Silicones of 200 and 1,000 centistokes (cs.) viscosity were so tested. The 200-cs. silicone was approximately equal to water in viscosity, and the 1,000 cs. silicone was about as viscous as mineral oil. It was immediately apparent that it was impossible to suspend the 1,000-cs. silicone with water and barium by ordinary means. On the other hand, a suspension was readily obtained with the 200-cs. silicone. Concentrations of silicone in water ranging from 10 per cent to 90 per cent formed a relatively stable suspension when combined with barium and showed an excellent adherence to the sides of the glass test tubes. The optimum was found to be 50 per cent silicone and 50 per cent water. The 100 per cent silicone-barium suspension was completely unstable. Observations over a period of forty-eight hours showed a definite superiority of the barium-water-silicone suspensions to ordinary barium-water suspensions when the concentration of silicone ranged from 10 per cent to 90 per cent in the diluent.

To determine whether barium-water-silicone suspensions had any advantage over barium-water-carboxymethylcellulose suspensions, both media were used to visualize the colon of a dog. Terminal ileum and colon were isolated as a Thiry-Vella fistula and intestinal continuity was re-established by ileosigmoidostomy. This segment of clean bowel was repeatedly utilized for the comparative observations. Following recovery from the operation, barium enema and pneumocolon studies were performed in this isolated colon with suspensions of barium-water-silicone 50 per cent and barium-water carboxymethylcellulose 5 per cent. The ingredients were suspended by means of an electric mixer. Comparison of the roentgenograms demonstrated no superiority of one medium over the other. Both were found to be satisfactory (Fig. 1). In a follow-up period of

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[2] Dow Corning 200 Fluid, generously furnished by Dow Corning Corp., Midland, Michigan.

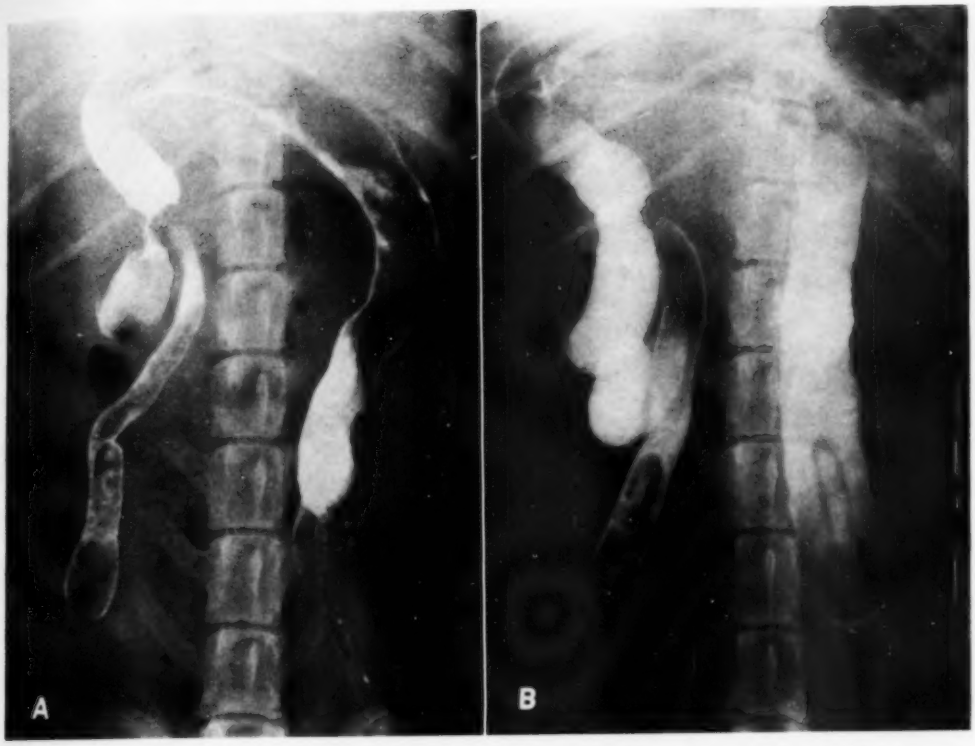

Fig. 1. A. Pneumocolon of isolated colon of dog with barium-water-silicone 50 per cent suspension.
B. Pneumocolon of same dog with a barium-water-carboxymethylcellulose 5 per cent suspension.

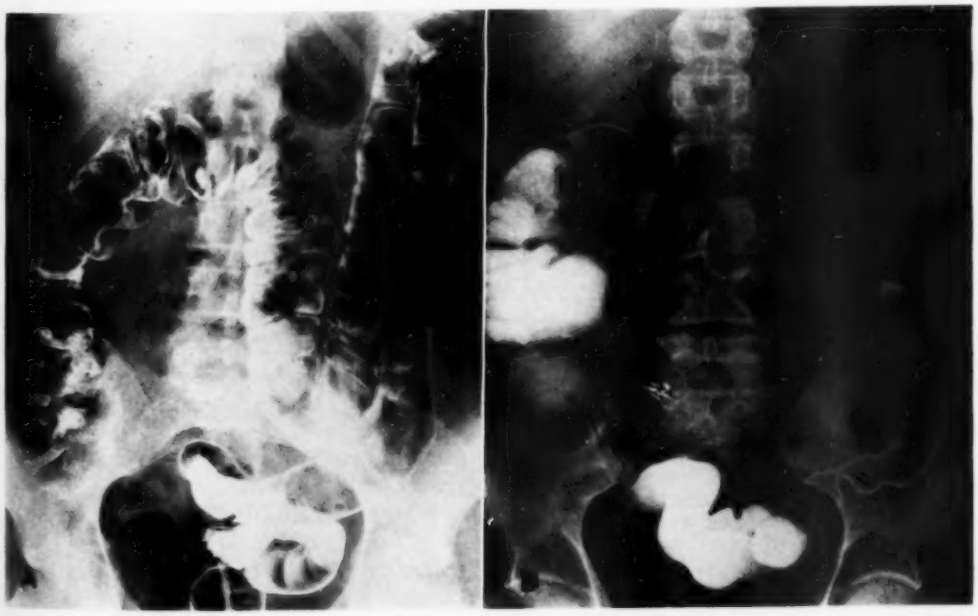

Fig. 2. A. Pneumocolon of man with barium-water-silicone 10 per cent suspension.
B. Pneumocolon of man with barium-water-carboxymethylcellulose 5 per cent suspension, showing better mucosal detail than in A.

three months there were no adverse effects.

Suspensions of barium-water-silicone were then tested in man. In the absence of available information concerning the action of silicones on the human colon, it was decided to use the smallest amount of silicone that produced adequate stability and adherence, namely, a barium-water-silicone 10 per cent suspension. This medium was used in 28 barium enemas, including 4 pneumocolons. The results obtained were compared with a similar group of examinations using a barium-water-carboxymethylcellulose 5 per cent suspension. This comparison again failed to demonstrate any significant advantage of one medium over the other. Close examination of the films gave the impression that with the carboxymethylcellulose suspension the distribution and mucosal adherence of the barium were somewhat superior (Fig. 2). The marked adherence of the barium-water-silicone suspension noted in glass was not manifest in the colon. Admittedly, higher concentrations of silicone, to 50 per cent, as used in the isolated colon of the dog, may show greater mucosal adherence.

SUMMARY AND CONCLUSIONS

The results of a pilot study utilizing suspensions of barium, water, and silicone as a medium for roentgen examination of the colon have been presented. Silicone of viscosity 200 centistokes is an excellent suspending agent for barium and is easily administered without toxic effects. In the low silicone (10 per cent) concentration studied, a barium-water-silicone combination appears to offer no real advantage over barium-water-carboxymethylcellulose suspensions.

University of California School of Medicine
San Francisco 22, Calif.

REFERENCES

1. ROWE, V. K., SPENCER, H. C., AND BASS, S. L.: Toxicological Studies on Certain Commercial Silicones and Hydrolyzable Silane Intermediates. J. Indust. Hyg. & Toxicol. **30**: 332–352, November 1948.
2. WHITROCK, R. M.: Unpublished observations.
3. ROWE, V. K., SPENCER, H. C., AND BASS, S. L.: Toxicologic Studies on Certain Commercial Silicones; 2 Year Dietary Feeding of "DC Antifoam A" to Rats. Arch. Indust. Hyg. **1**: 539–544, May 1950.

SUMARIO

La Aplicación de Silicones a la Roentgenología del Colon

Preséntanse los resultados de un estudio explorador en que se utilizaron suspensiones de bario, agua y silicón como medio para el examen radiológico del colon. Se hicieron estudios en perros y en el hombre los silicones de una viscosidad de 200 centistokios constituyen un suspensivo excelente para el bario y se administran fácilmente sin efectos tóxicos. Con la concentración baja (10 por ciento) de silicón estudiada, una combinación de bario-agua-silicón no parece ofrecer la menor ventaja real sobre las suspensiones de bario-agua-celulosa carboximetílica.

Carcinomatous Invasion of the Jaw Bones Roentgenographically Considered[1]

ROBERT S. SHERMAN, M.D., and FLORENCE C. H. CHU, M.D.

INVASION OF the jaw bones by continuity is a frequent occurrence in neoplasms originating in the gums; it is not unknown in cancers of the antrum, hard palate, floor of the mouth, tonsil, nasal cavity, buccal mucosa, tongue, soft palate, lip, and salivary glands, and it may occur as a result of cancer eroding from a nearby lymph node. Clinical examination alone is often inadequate to determine the presence or absence of jaw bone involvement, or its extent. In our experience, for example, it has not been unusual for carcinoma of the antrum to be diagnosed clinically and pathologically as gum cancer until the roentgenologist demonstrates the site of origin in the antrum. Since such information is essential for thorough treatment, x-ray evaluation of the jaws in patients having a cancer of a neighboring structure is regularly indicated (1, 9).

Little seems to have appeared in the roentgen literature about the x-ray diagnosis of jaw bone invasion by carcinoma, although brief references can be found in textbooks and medical journals in discussions of individual cancers. It is the purpose of this paper to report the roentgenographic features of jaw bone invasion from a representative group of carcinomas of various anatomical sites in the region of the mouth.

A total of 61 cases have been selected for study from a much larger group. All of those selected have had adequate roentgen coverage of the jaw, and almost all have been proved following jaw resection, with more or less complete anatomical study and histologic diagnosis. In the few cases not having a jaw resection histologic proof was available and there seems no doubt as to the validity of the findings. Cancer of the gum, as might be expected, constituted the most numerous category, with 38 cases (5). The other cancers making up the material are as follows: antrum, 10; hard palate, 3; floor of mouth, 2; tonsil, 2; nasal cavity, 1; buccal mucosa, 1; tongue, 1; soft palate, 1; salivary glands, 1; metastatic lymph node, 1.

ROENTGEN TECHNIC

The roentgen interpretation of jaw bone invasion requires careful technic for the best results. It was not until a basic routine coverage was established by the x-ray department as constituting the acceptable minimum that we were assured of a dependable examination and that patients were freed from the necessity of return visits for needed films. By this system the clinician merely specifies the anatomical site of the tumor. The technician then obtains the routine film coverage that the roentgenologist has established for that area. Experience indicates, however, that while it is possible for the roentgenologist to standardize the examination, he must be ready to see any individual patient who may present a special problem.

As relates to jaw lesions, special stress is laid upon moving grid films, the use of small cones, and a rotating anode tube with fine focal spot. A well placed dental or occlusal film may be of the utmost value, showing clearly changes that have escaped detection on regular films. The basic or minimum routine for cancer of the various anatomical sites that may invade the jaws is as follows:

The upper jaw, with particular reference to the alveolus

1. Stereoscopic sagittal view of antra (open mouth)
2. Stereoscopic lateral view of face
3. Single oblique view of maxilla (if indicated)

[1] From the Department of X-ray Diagnosis, Memorial Center for Cancer and Allied Diseases, New York, N. Y. Accepted for publication in October 1954.

Fig. 1. Cancer of the gum invading bone in a fairly typical manner.
Fig. 2. Erosion of bone from one side of the ramus, presenting as a central defect.

4. Occlusal film
5. Intraoral dental films (if indicated)

The mandible

A. Posterior to canine
   1. Stereoscopic oblique view of mandible
   2. Single postero-anterior view of mandible
   3. Occlusal film
   4. Dental films (if indicated)
B. Anterior to canine
   1. Stereoscopic special oblique view of mandible
   2. Single postero-anterior view of mandible
   3. Occlusal film of anterior mandible
   4. Dental films (if indicated)
C. Ramus of mandible
   1. Stereoscopic special oblique view of mandible
   2. Single postero-anterior view of mandible
   3. View of temporo-mandibular joint

ROENTGEN FINDINGS

Carcinoma of the Lower Gum: There were 35 carcinomas of the lower gum which were seen to affect the mandible. The site of bone invasion was the angle in 5, the body in 28, and the symphysis in 2. The area of bone destruction varied from 1 to 7 cm. in diameter, 3 cm. representing the average. In 30 of the 35 cases the bone lesion was along the alveolus, exhibiting a V-shape, shallow in 11 instances and deep in 19 (Fig. 1). In the other 5 cases the invasion was on the lateral or medial side of the jaw, the bulk of the disease being in the medullary portion (Fig. 2.) The edges were distinct in 19, indistinct in 12, and ragged or irregular in 4. In 10 cases there were a few tiny fine shreds and flecks representing bone fragments within the destroyed area. The remaining 25 cases did not have visible bone fragments. Teeth were absent in 30 cases. In the 5 cases in which teeth were present, these showed no effect in 1 and loss of lamina dura in 4 (Fig. 3). Periosteal reaction was absent in all but 1 case, in which slight periosteal proliferation was suspected. A soft-tissue mass was definitely seen in only 2 cases, 1 of which contained a few small calcific flecks. There was only 1 pathological fracture. The rate of enlargement of the area of bone involvement is best demonstrated by 2 tumors, 1 of which increased in size from 1 × 1.5 cm. to 2 × 3.5 cm. in two and a half months (Fig. 4), while the other doubled its size in ten months.

Fig. 3. Cancer of the gum invading bone in the usual manner. The relation of a tooth to the tumor is demonstrated.

The x-ray findings recorded for cancer of the lower gum were duplicated quite closely in cancers invading the jaw from

other neighboring structures. However, a short summary of the changes actually occurring with each of the neoplasms is included for the sake of completeness.

Carcinoma of the Upper Gum: One of the cancers originating in the upper gum was in the incisor region and the other 2 were in the molar area. No periostitis, soft-tissue mass, or fracture was associated with these tumors. The average diameter was 3 cm., and all showed slightly indistinct and ragged edges. Two contained a few 1- to 2-mm. fragments. These lesions were best seen on intraoral roentgenograms (Fig. 5). One presented destruction extending into the anterior wall of the antrum and the other 2 revealed the deep saucerized shape characteristic of direct carcinoma invasion along the alveolar margin.

Fig. 5. Occlusal film showing a cancer of the upper gum invading the jaw in the usual manner.

Fig. 4. Rate of growth of cancer of the gum invading bone. No treatment has been given. A. Appearance of process initially. B. Appearance two and a half months later, showing a substantial increase in size in the bone defect.

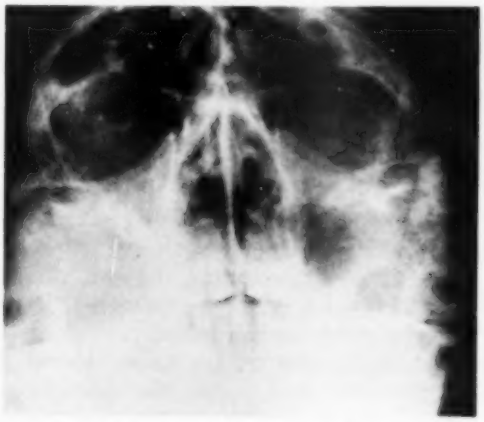

Fig. 6. Antral cancer diagnosed clinically as cancer of the gum. Roentgen study determined the antral origin.

Carcinoma of the Antrum: The 10 carcinomas arising in the antrum produced no periosteal reaction, fracture, or bone fragmentation. The area of bone involvement was irregular in shape, the edges were indistinct, and usually a soft-tissue mass was seen. The average size was 4 to 5 cm. in diameter. In 2 of this group a clinical diagnosis of carcinoma of the gum was corrected by the x-ray report of an antral carcinoma (Fig. 6).

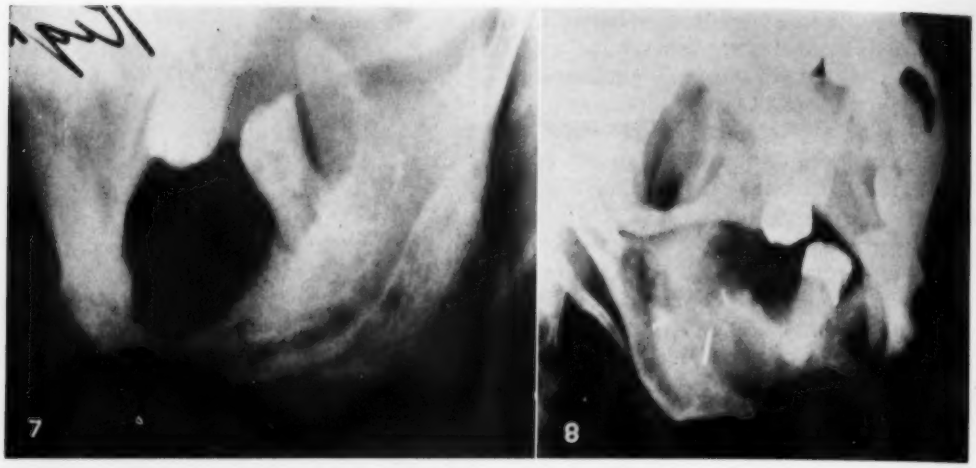

Fig. 7. Carcinoma of the floor of the mouth with bone destruction in the jaw.
Fig. 8. Cancer of the tonsil invading the ramus of the jaw.

Carcinoma of the Hard Palate: All the carcinomas of the hard palate produced relatively extensive destruction of bone, with the lesion tending to extend to the molar area. The destructive process varied from 2 to 5 cm. in diameter, with indistinct borders. In 1 case there was a mass in the antrum. No significant effect was seen on the teeth, nor was there any periosteal reaction.

Carcinoma of the Floor of the Mouth: Two tumors originated in the floor of the mouth. One of these was recurrent after resection, and the saucerized area of bone invasion occurred at the resected end of the body of the left mandible anteriorly. Its size was approximately 1 × 2 cm., and its borders were fairly distinct. There were bone fragments in the destroyed area. The other tumor showed the fairly characteristic shallow V-shaped bone erosion at the alveolus of the body of the mandible. The overall area of bone loss measured 3 × 1.5 cm. Its edges were ragged and it contained a few tiny bone fragments (Fig. 7). No soft-tissue mass or periosteal reaction was noted in either tumor.

Carcinoma of the Tonsil: Two cancers of the tonsil were seen with bone destruction. One destroyed bone in the upper part of the ramus (Fig. 8) and 1 in the maxilla. The edges were ill-defined, and a few tiny bone fragments were present in both instances. In neither was there any periosteal reaction or soft-tissue mass. Teeth were absent. One case, followed over a two-year period, showed progressive bone destruction in the antrum, nares, orbit, and finally skull base.

Carcinoma of the Nasal Cavity: Bone involvement by the 1 carcinoma arising in the nasal cavity extended into the right maxilla and antrum, causing an area of bone loss approximately 6 × 5 cm. A few free fragments of bone were present and there was a soft-tissue mass, the edges of which were indistinct.

Carcinoma of the Buccal Mucosa: A single case of carcinoma of the buccal mucosa was studied, showing a 1 × 0.5-cm. shallow area of bone loss along the dental ridge. Unfortunately the specimen of the resected jaw was lost and therefore no final pathological confirmation of bone invasion could be obtained.

Carcinoma of the Tongue: There was one case of carcinoma of the tongue involving the jaw bone. This was seen in the roentgenogram as a 1.25-cm. area of very shallow alveolar erosion with distinct edges. There was no periosteal reaction, fragmentation, or mass.

Carcinoma of the Soft Palate: A single carcinoma originating in the soft palate

was found, which by extension from the original site showed a 3.5 × 1.5 cm. area of destruction in the mandible at the angle area. No teeth were present, nor was any mass noted on the roentgenogram. There was no fracture or periosteal reaction. Borders of the area of destruction were fairly distinct and a few faint, tiny septa were seen. It was the alveolus that was involved and the area of destruction was long and shallow.

Carcinoma of the Submaxillary Gland: In 1 instance bone destruction due to invasion in the body of the mandible was associated with a submaxillary gland cancer. The area of involvement had indistinct edges and later some irregular fragments of bone and septa formed. The destruction appeared first in the medullary part of the jaw, later extending to the alveolus. The area of bone loss increased from 3 × 1.5 cm. to 5 × 2.5 cm. in four months. In this particular instance, the x-ray appearance was considered to be rather atypical for carcinoma invading bone, largely because of the tendency to septa formation.

Metastatic Carcinoma: One case of erosion of the lower margin of the mandible over a 4 × 1 cm. shallow area appeared to be secondary to metastatic cancer of the submaxillary lymph node. Borders were ill-defined and no periosteal reaction occurred.

Summary of X-ray Findings: The most important roentgenographic features of invasion of the jaw bones by cancer of adjacent structures may now be summarized. The bone destruction occurs most commonly at the alveolus and usually is apparent as a V-shaped area of erosion, which is rather characteristic. The edges may be either distinct, ill-defined, or at times slightly ragged. There is usually no internal pattern except for the occasional presence of a few tiny bone fragments. There is no bone production and there is seldom any periosteal reaction. A soft-tissue mass may be seen in cases of carcinoma of the antrum but rarely can be identified in other situations. Teeth, if present within the tumor area, usually exhibit destruction of the lamina dura.

DIFFERENTIAL DIAGNOSIS

Osteomyelitis is a condition often of special concern in differential diagnosis by the roentgenologist. In addition, he occasionally has to deal with the possibility of radiation osteitis, and at times both conditions are present along with carcinomatous bone invasion.

The x-ray diagnosis of osteomyelitis of the jaw has been described many times. Suffice it to say here that the presence of patchy bone destruction in the medullary part of the bone, of diffuse distribution, often associated with some degree of sclerosis and revealing at times sequestration and periosteal reaction, is sufficiently dissimilar from cancer invasion to make an x-ray differentiation relatively reliable in most instances.

The recognition of radiation osteitis is more difficult, particularly in thinned atrophic jaws (2, 8). Advanced cases are usually accompanied by some degree of osteomyelitis and radiographically, therefore, they present predominantly the features of a chronic osteomyelitis, especially as regards bone sclerosis and deposits of free dead bone. Radiation osteitis seen before infection sets in is manifest by a slight degree of irregular diffuse bone sclerosis with faint cortical irregularity and shagginess. At this stage, detection may be more reliable by clinical means, especially if the affected bone is exposed to the view of the examiner. It is readily apparent that none of these conditions present the characteristic V-shaped and localized bone erosion of cancer invasion.

Certain osteogenic sarcomas of the jaw, of the lytic type, may be impossible to differentiate radiographically from cancer invading the jaw bone. Usually the presence of a soft-tissue mass and the arrangement of a few amorphous calcific flecks will serve for identification (6).

An epulis might also be impossible to distinguish radiologically from jaw invasion by a nearby cancer. Again the pres-

ence of a soft-tissue mass with flecks of calcification more or less characteristically placed might serve as a clue to the real nature of the lesion. In both this disease and in certain osteogenic sarcomas the shape of the bone destruction at the alveolus may be strikingly like that of carcinomatous invasion of the jaw (4, 5).

Rarely a blood-borne metastatic deposit may cause cortical bone destruction with roentgen changes resembling those of cancer erosion. Almost always, however, deposits will be multiple and medullary in location, with little or no extension beyond the bone (9).

SUMMARY AND CONCLUSIONS

1. The x-ray diagnosis of jaw bone invasion by carcinoma arising in neighboring structures has been studied in 61 histologically proved cases.

2. A plan for basic film coverage to demonstrate lesions involving the various areas of the jaws has been presented.

3. Fairly uniform and characteristic roentgen changes have been found in most instances.

4. The differential diagnosis of carcinomatous invasion of the jaws has been considered.

444 East 68th St.
New York 21, N. Y.

REFERENCES

1. BLAIR, V. P., BROWN, J. B., AND BYARS, L. T.: Cancer of the Cheek and Neighboring Bone. Am. J. Surg. **30:** 250–253, November 1935.
2. COOK, T. J.: Late Radiation Necrosis of the Jaw Bones. J. Oral Surg. **10:** 118–137, April 1952.
3. DALAND, E. M.: Radiation Necrosis of the Jaw. Radiology **52:** 205–215, February 1949.
4. LAWRENCE, E. A.: Osteoradionecrosis of the Mandible. Am. J. Roentgenol. **55:** 733–742, June 1946.
5. MARTIN, H. E.: Cancer of the Gums (Gingivae). Am. J. Surg. **54:** 765–806, December 1941.
6. SHERMAN, R. S.: Résumé of the Roentgen Diagnosis of Tumors of the Jawbones. Oral Surg. **4:** 1427–1443, November 1951.
7. SHERMAN, R. S., AND CAUMARTIN, H.: The Roentgen Appearance of Adamantinoma of the Mandible. Radiology **65:** 361–367, September 1955.
8. SHERMAN, R. S., AND MELAMED, M.: Roentgen Characteristics of Osteogenic Sarcoma of the Jaw. Radiology **64:** 519–527, April 1955.
9. WARD, G. E., AND HENDRICK, J. W.: Diagnosis and Treatment of Tumors of the Head and Neck, Not Including the Central Nervous System. Baltimore, Williams & Wilkins Co., 1950.
10. WATSON, W. L., AND SCARBOROUGH, J. E.: Osteoradionecrosis in Intraoral Cancer. Am. J. Roentgenol. **40:** 524–534, October 1938.
11. WILNER, D.: A Roentgen Study of Skeletal and Intrathoracic Metastases from Salivary Gland Cancer. Radiology **55:** 801–806, December 1950.

SUMARIO

La Invasión Carcinomatosa de los Maxilares Considerada Roentgenográficamente

A base de una serie de 61 casos, discútense las características radiográficas de la invasión de los maxilares por carcinoma de los tejidos adyacentes. La invasión procedía de la encía en 38 casos, del seno maxilar en 8, del paladar duro en 3, del suelo de la boca en 2, de la amígdala en 2, y de la mucosa bucal, la lengua, el paladar blando, las glándulas salivales y de un ganglio linfático metastático en 1 caso cada uno.

Bosquéjase un sistema básico para el examen roentgenológico, y se describen los hallazgos roentgenológicos observados en esta serie. La destrucción ósea ocurre más frecuentemente en el alvéolo y suele traducirse por una zona de erosión en forma de V, cuyos bordes pueden ser precisos, mal definidos o a veces ligeramente mellados. No suele haber patrón interno, excepto por la presencia ocasional de algunos pequeños fragmentos óseos. No hay osteogenia y rara vez existe la menor reacción perióstica. En los casos de carcinoma del antro de Highmore, tal vez se observe una tumefacción de tejido blando, pero raramente en otras situaciones. Los dientes, si los hay en la zona tumorosa, suelen manifestar destrucción de la lámina dura.

Hay que diferenciar de la osteomielitis, la osteítis por irradiación, ciertos sarcomas osteógenos, la epulia y los depósitos metastáticos transportados por la sangre.

Milkman's Pseudofractures of the Ribs Following Extraperiosteal Ivalon Pack[1]

SAMUEL L. COHEN, M.D.

EXTRAPERIOSTEAL Ivalon pack is a procedure used by thoracic surgeons in the collapse treatment of pulmonary tuberculosis. With this technic the periosteum is stripped completely from the ribs, allowing the parietal and visceral pleura to fall inward, thus creating an extrapleural space, which is then packed with the synthetic material, Ivalon. The Ivalon is usually removed in three to five months and a small thoracoplasty is performed. In some cases, and for various reasons, the material is left *in situ* indefinitely.

In 1934, Milkman described the case of a forty-three-year-old white female with band-like radiolucent zones in the bones. These areas tended to be unilateral and symmetrical, though they were not invariably so. Subsequent fracture and deformity occurred. A thorough study of the case ruled out osteomalacia and nutritional and glandular causes. All laboratory tests were negative. During the course of the disease diabetes mellitus developed. Postmortem a rather generalized arteriosclerosis was reported. Findings were otherwise negative.

Steinbach, Kolb, and Gilfillan, on the basis of aortographic studies of a patient with Milkman's pseudofractures suggested that the defects were the result of erosion of the softened (osteomalacic) bones by the adjacent pulsating blood vessels. Winston and Pendergrass reported a case which improved with vitamin D therapy and concluded that in this instance lack of the vitamin was responsible for the bone lesions. They regarded Milkman's disease as a stage in the development of generalized osteomalacia. Albright recorded examples of Milkman's fractures associated with renal acidosis and with idiopathic hypercalciuria and hyperparathyroid disease. He, too, believed that Milkman's fractures represent a stage of generalized osteomalacia.

In the routine serial follow-up examination of a patient treated for tuberculosis by an extraperiosteal Ivalon pack, the present author discovered a typical Milkman's pseudofracture of the right first rib. Painless fractures had also occurred in the second, third, and fourth ribs. Seventeen additional cases which had been similarly treated at Whipple Veterans Administration Hospital were then reviewed. Fourteen of the patients had undergone reoperation in three to six months. No roentgen evidence of rib deformities could be discovered in these re-operated cases, though gross rib changes were always present at surgery. Two cases showed minor generalized rib changes on x-ray examination, compatible with bone atrophy. In 1 case the findings completely simulated those in the case described above. Here, too, a Milkman's fracture of the right first rib was seen.

An interval of approximately six to twelve months is necessary before definite changes in the ribs are demonstrable radiologically following periosteal stripping. Gross specimens (Fig. 1) show the pathological changes which are still not visible on the films. The ribs shown in Figure 1 were removed approximately three months after the initial operation. Microscopically, there is dissolution of the medulla, with cortical erosion. There is an over supply of osteoclasts and polymorphonuclears. According to the pathologist, "the structure resembles that of an aseptic necrosis." There is some proliferation of fibroblasts.

DISCUSSION

It is apparent from the above findings that Milkman's fractures represent a stage of bone atrophy or osteomalacia. In the

[1] Accepted for publication in October 1954.

Fig. 1. Ribs removed three months after extraperiosteal Ivalon pack.

CASE HISTORIES

CASE I: A 40-year-old white male had a bilateral stationary widespread nodular tuberculosis with sputum positive for acid-fast bacilli. On May 20, 1953, a right upper extraperiosteal Ivalon pack was performed. Serial films showed no changes until April 30, 1954, when a typical Milkman's zone (Fig. 2) was seen in the right first rib. There were also fractures of the right second to fourth ribs. There was no history of trauma.

CASE II: A 58-year-old white male with chronic pulmonary tuberculosis since 1946 was treated by an extraperiosteal pack on Jan. 6, 1953. Serial films showed no changes until March 1, 1954, when a Milkman's pseudofracture of the right first rib was demonstrated (Fig. 3).

SUMMARY

Two cases of Milkman's pseudo fractures following extraperiosteal Ivalon pack are reported. These fractures are apparently trophic in nature, being due to the surgical removal of the periosteum with the nerve and/or blood supply. The bone lesions are evident on gross pathologic examination some months before they are demonstrable roentgenologically.

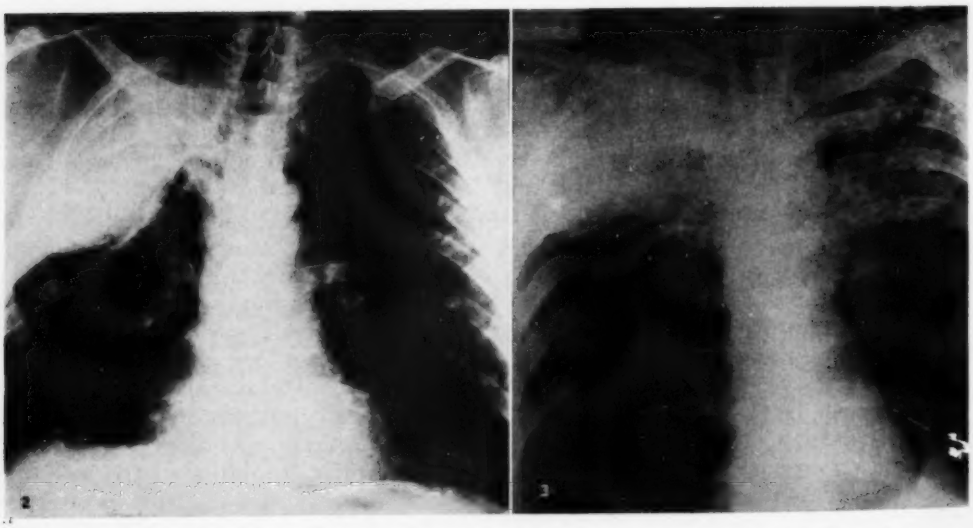

Fig. 2. Case I. Milkman's pseudofracture of the right 1st rib; fractures of the 2nd to 4th right ribs.
Fig. 3. Case II. Milkman's pseudofracture of the right 1st rib.

cases described the changes were due to altered nutrition of the affected bones as a result of the periosteal stripping. It would seem that any disorder, either general or local, which can affect the bone nutrition can produce Milkman's pseudofractures.

NOTE: I wish to thank Dr. William Marlowe, Prescott, Ariz., Dr. Robert E. Campbell, V. A. Hospital,

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RADIOLOGY

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This issue in 2 parts—Part 2

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ACUTE ABDOMEN SEMINAR

RADIOLOGICAL SOCIETY OF NORTH AMERICA

Forty-First Annual Meeting, Chicago, 1955

Wednesday, December 14, 2–4 P.M.

PANEL

Morton I. Grossman, M.D., Chief of the Physiology Division of the Medical Nutrition Laboratory, Fitzsimons Army Hospital, Denver, Colo.

I. S. Ravdin, M.D., John Rhea Barton Professor of Surgery, Hospital of the University of Pennsylvania, Philadelphia, Pa.

Leo G. Rigler, M.D., Professor of Radiology, University of Minnesota, Director, Department of Radiology, University of Minnesota Hospital, Minneapolis, Minn.

Philip J. Hodes, M.D., *Moderator*

Bring this booklet to the meeting

ACUTE ABDOMEN SEMINAR

You will find here illustrations and descriptions of 7 acute abdominal lesions which will be discussed at a Seminar on Wednesday, December 14, from 2 to 4 P.M., during the meeting of the Radiological Society of North America. These are now being presented as Part II of the October issue of RADIOLOGY so that they can be studied by you before the Seminar. The cases will serve as a nucleus for a review of the clinical, physiological, and roentgen manifestations of acute abdominal diseases.

At the Seminar each case will be thoroughly discussed by the members of the panel. Pertinent follow-up data will be supplied at that time in order to present the complete picture.

In order to stimulate interest we hope that you will let us have your diagnosis in each case before the meeting. These should be listed on the lower half of this page, which may be torn off and mailed to Dr. Philip J. Hodes, Hospital of the University of Pennsylvania, 3400 Spruce St., Philadelphia 4, Pa. If these reach him by Nov. 15, 1955, they will be tabulated and presented at the Seminar. Do not sign your name unless you wish to do so.

Test your diagnostic acumen: Send us your diagnoses promptly.

Note: **The original roentgenograms will be on display in the Scientific Exhibits Hall during the week of the meeting.**

ACUTE ABDOMEN SEMINAR

Case I.

Case II.

Case III.

Case IV.

Case V.

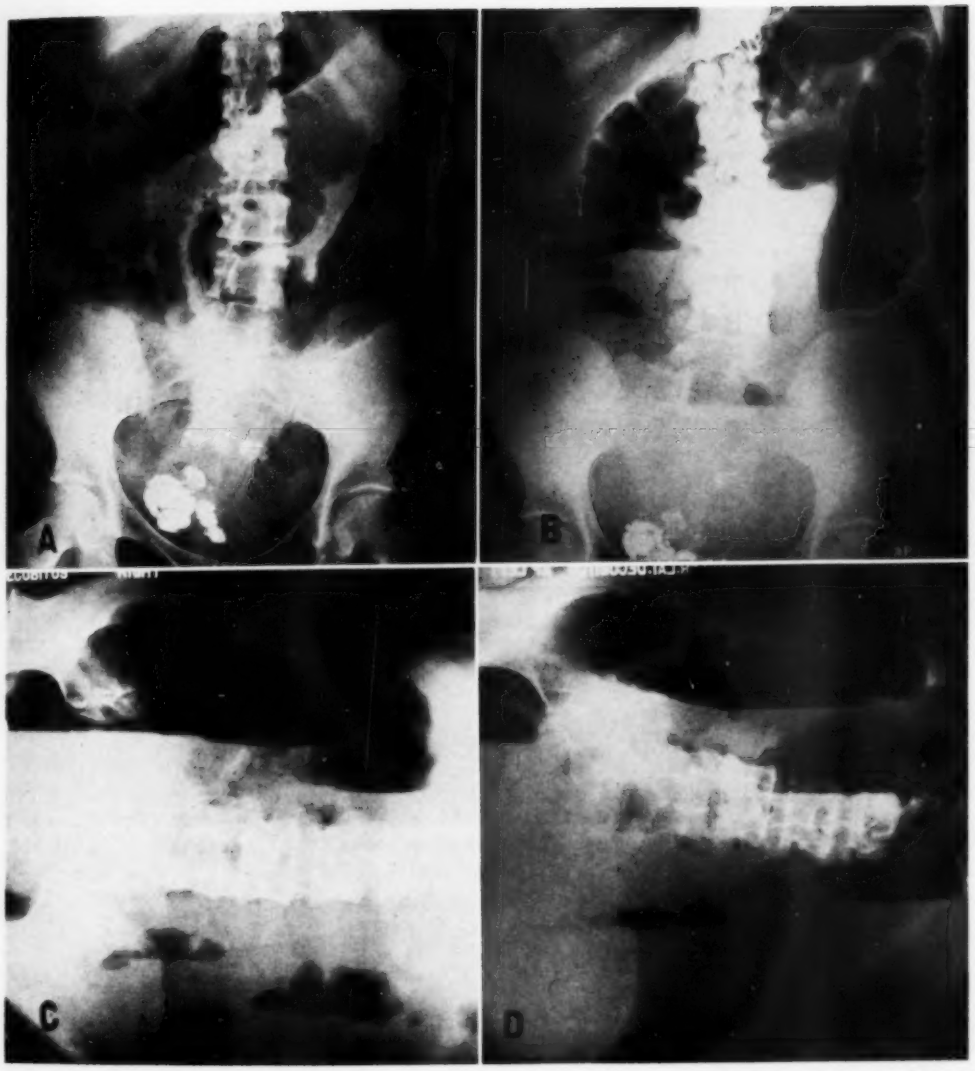
Case VI.

Case VII.

CASE 1 (C. L.)

A 56-year-old woman was admitted to the hospital with a one-month history of crampy abdominal pain and loss of appetite. Four days prior to admission she noticed that her abdomen was getting tight, and therefore consulted her family doctor. She was referred for a barium enema examination, following which she was hospitalized. Upon admission to the hospital she stated that she had had no bowel movements and had passed no gas rectally for the past three days. She also had begun to vomit small amounts of fluid just prior to hospitalization.

The past medical history was unimportant. Physical examination revealed a patient in distress but not acutely ill. The vital signs were all within normal limits. The abdomen was distended and tympanitic, with high-pitched tinkling peristalsis and peristaltic rushes easily discernible. There was no localized tenderness; no masses could be felt. The rectal examination was negative. Laboratory studies on admission revealed a hemoglobin of 82 per cent; white cell count 7,200; urinalysis and blood chemistry negative.



Case I. The roentgen examinations were made in the following positions: A. Supine. B. Erect. C. Left lateral decubitus. D. Right lateral decubitus.

Note: The term "left lateral decubitus" indicates that the patient is lying on the left side with the right side uppermost. The term "right lateral decubitus" means that the patient is lying on the right side with the left side uppermost. This nomenclature will be used for all of the illustrations.

A and B are retouched.

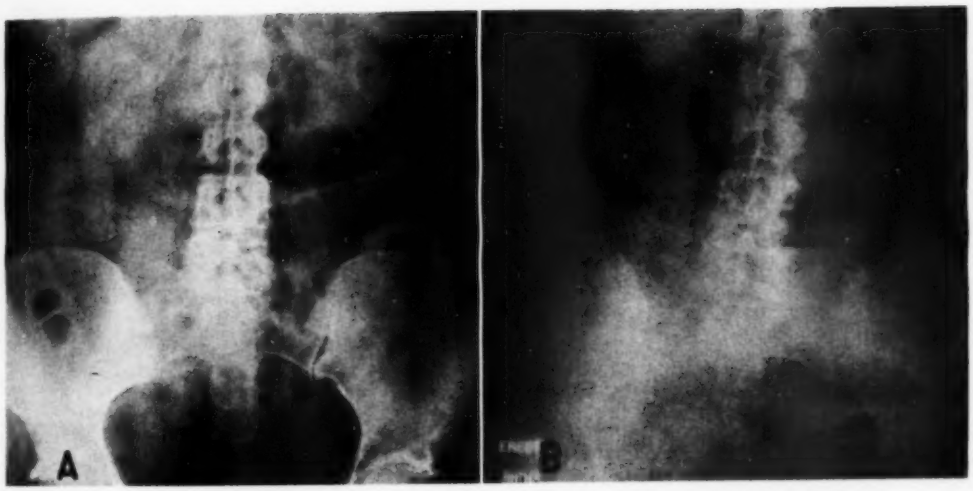
CASE II (C. R.)

A 52-year-old woman was admitted to the hospital with a twelve-hour history of crampy generalized abdominal pain and nausea. The pain, originally intermittent, had now become constant. There was no radiation of the pain. The patient had one loose bowel movement following an enema prior to admission. Feeling nauseated, she had induced vomiting, which did not relieve her symptoms. The pain became gradually worse. Her family physician, finding her abdomen tender and quiet, gave her morphine and referred her to the hospital.

On admission to the hospital the pain had been relieved.

The past medical history indicated that the patient was a known hypertensive who had had one episode of congestive failure six months previously. She had had two abdominal operations, the first a uterine suspension and the second a hysterectomy thirteen years later, fifteen years before her present illness. The past history was otherwise negative.

On admission the patient seemed perfectly comfortable. Her blood pressure was 176/110, pulse 88, temperature 98.6°, and respirations normal. Physical examination revealed a soft belly with a little tenderness in the left lower quadrant and the epigastrium. There was no rebound tenderness. The abdomen was quiet, with a few peristaltic sounds heard intermittently, which seemed normal. There were no masses. Pelvic and rectal examinations were negative. Laboratory studies on admission showed hemoglobin 88 per cent; white cell count 8,000; carbon dioxide 26.5 millimols per liter; blood chloride 103 mg. per cent; urine negative.



Case II. Roentgen examinations were made in the following positions: A. Supine. B. Erect.

CASE III (R. K.)

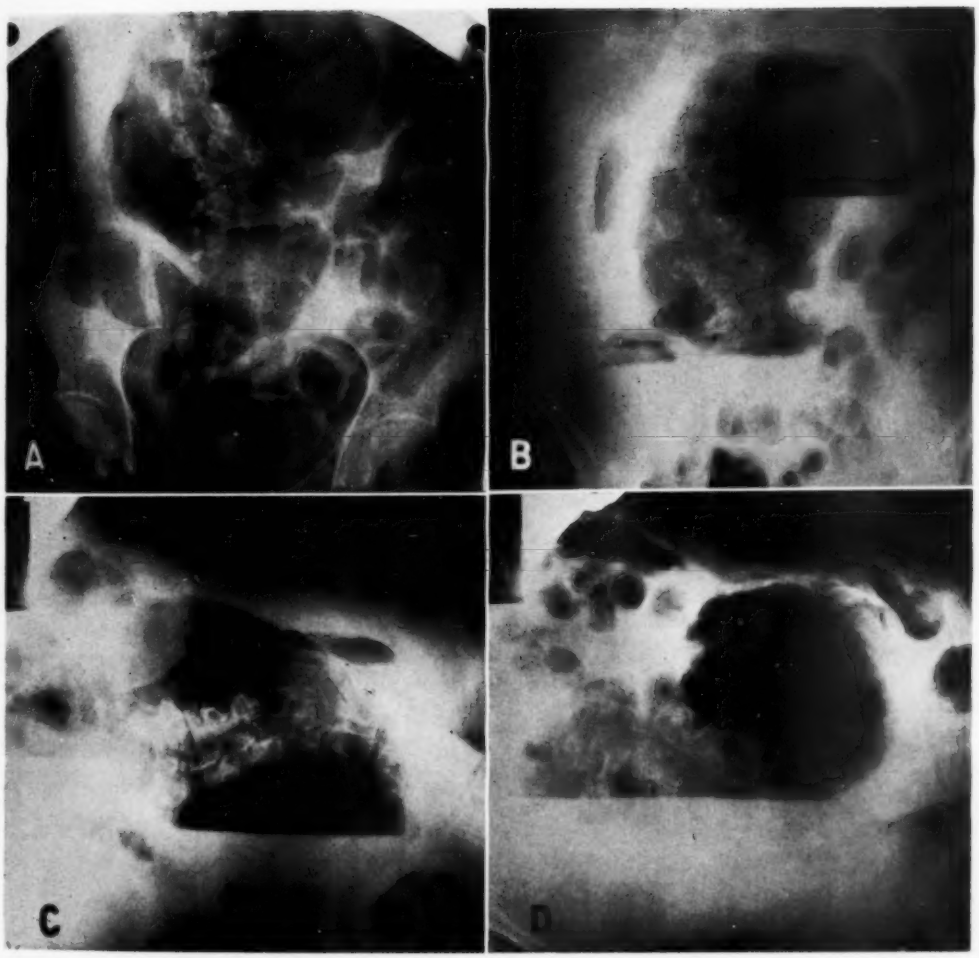
A 62-year-old woman, acutely ill, was admitted to the hospital with a history of abdominal distention for one week, associated with generalized crampy abdominal pain. She had had multiple enemas during this time, passing small amounts of feces and gas with each enema, followed by partial relief of symptoms. She had vomited several times during the four days prior to admission.

The past history included similar episodes of abdominal distention and pain, for which the patient had been hospitalized three times during the previous two years and a half. With each attack she was nearly operated upon, but in each instance her symptoms disappeared following enemas and the use of rectal and stomach tubes. There was a history of a heart attack three years previously, with hospitalization for six months; since this attack the patient had noted decreased exercise tolerance, dyspnea, and occasional ankle edema.

The patient also gave a history of multiple abdominal operations, the first having been performed forty years previously. Surgical procedures included an appendectomy, at which time a "tumor" of the bowel was removed, two laparotomies for lysis of adhesions, 2 pelvic operations followed by hysterectomy, bilateral simple mastectomy.

On admission the blood pressure was 140/80, temperature 100°, pulse 88, respirations 22. The patient appeared to be in moderate distress. Tenderness was generalized, with no rebound tenderness elicited. Peristalsis was high-pitched and tinkling and suggested mechanical obstruction. There were no localizing abdominal signs. The rest of the physical examination was negative. Laboratory studies on admission showed hemoglobin 45 per cent, white blood cell count 5,400; urinalysis and blood chemistry within normal limits.

Case



Case III. Roentgen examinations were made in the following positions: A. Supine. B. Erect. C. Left lateral decubitus. D. Right lateral decubitus.

CASE IV (M. R.)

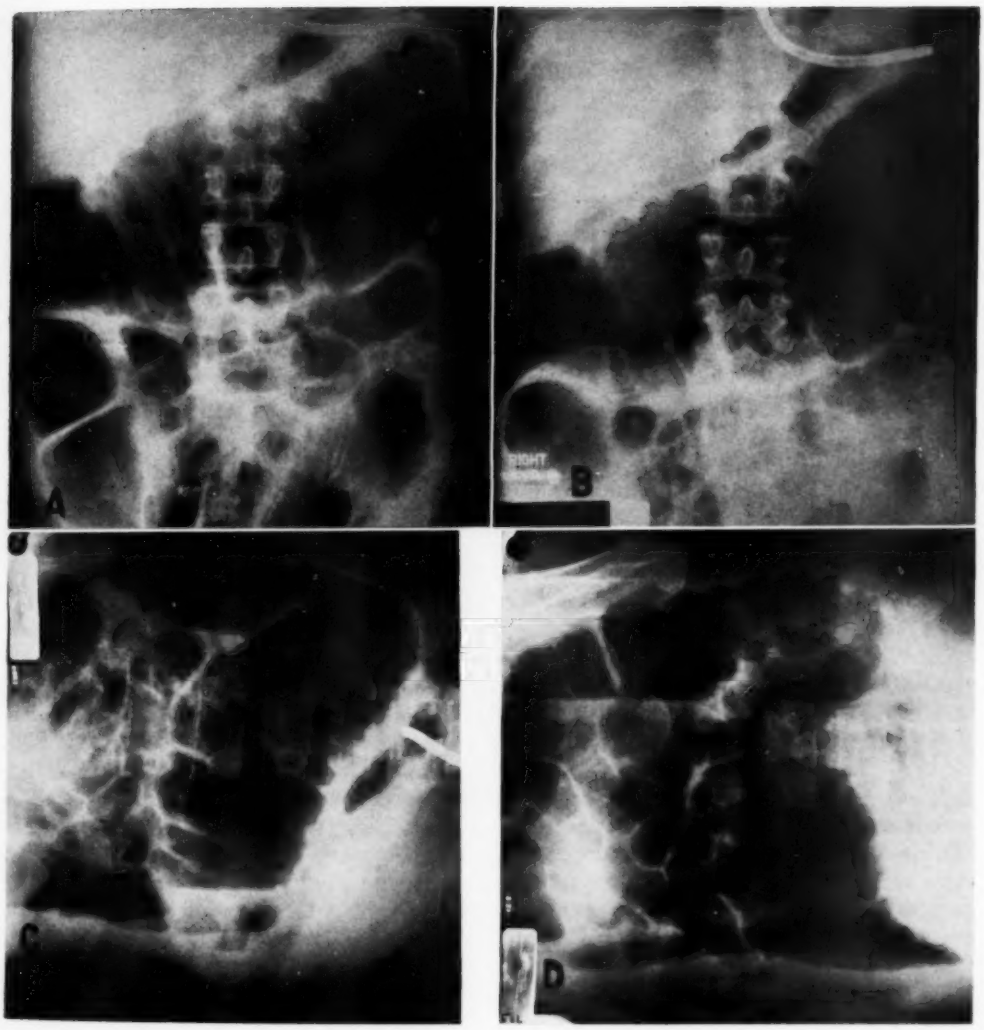
A 54-year-old male was admitted to the hospital in acute distress, with a history of bloody diarrhea of four weeks duration, weakness, severe anorexia, mild crampy generalized abdominal pain, and a 5-pound weight loss, during the week prior to admission. A temperature of 104° was discovered by his family physician twenty-four hours before admission. The patient was not aware of fever previously. The diarrhea was of gradual onset and increasing severity. No history of a previous acute abdominal episode could be obtained.

During the four-week illness, stools had been as frequent as 15 per day. Some stools were normal in color; others were flecked with blood, and some were blood tinged. The patient's appetite had been very poor, his diet consisting mostly of soft foods and liquids. There was no history of vomiting. There had been no diarrhea or other abdominal complaints prior to the onset of the present illness. The past medical history was unimportant.

On admission the patient appeared chronically ill but not in severe distress. His temperature was 102°, pulse 112, respirations 26, blood pressure 130/50. The abdomen was tympanitic, a little distended, and slightly tender to palpation; slight rebound tenderness, which was not localized, was elicited. No organs or masses were felt. Active peristalsis was present. The rest of the physical examination was negative.

The laboratory findings on admission were as follows: hemoglobin 78 per cent; white blood count 8,800, with 74 per cent neutrophils; BUN 10; total plasma protein 5.3, with albumin 2.9 and globulin 2.4. A smear of the stool revealed many red cells but no ova or parasites; stool cultures were negative.

Case



Case IV. Roentgen examinations were made in the following positions: A. Supine. B. Erect. C. Right lateral decubitus. D. Left lateral decubitus.

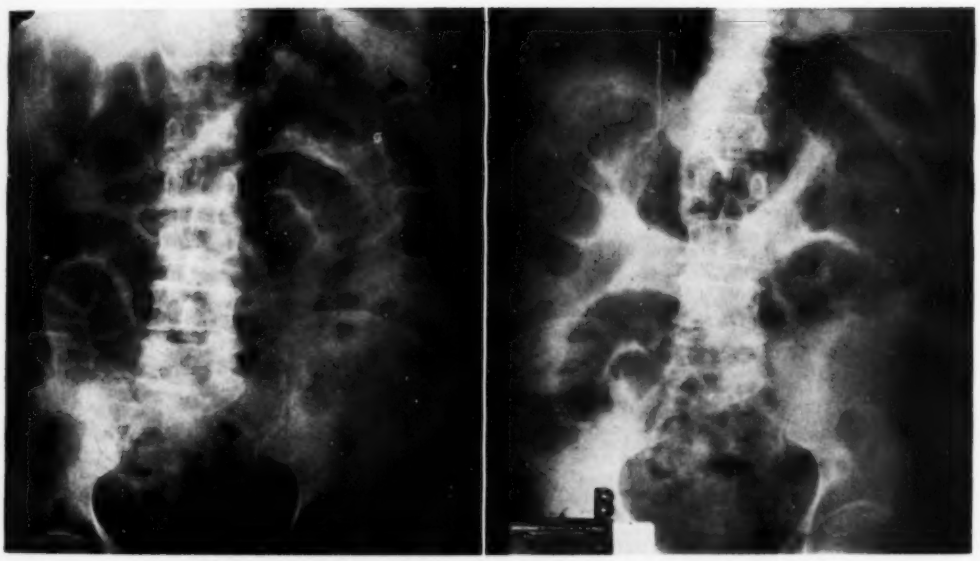
CASE V (J. W.)

A 60-year-old man was admitted to the hospital, critically ill. For three days prior to admission he had complained of lower abdominal pain, abdominal distention, and fever. Because the patient was disoriented, the family supplied the history. According to this, the pain originally was not localized but was a dull, constant ache, which gradually became worse. Its onset was accompanied by fever, which at times reached 103°. Two days prior to admission the patient complained of anorexia and vomited on several occasions. The vomitus was bile-stained and contained no blood. There had been no bowel movements since the onset of the illness.

For two days the patient had noticed increasing abdominal distention. He continued to pass gas per rectum during the three days prior to hospitalization.

According to the family, the patient had been taking an unknown amount of cortisone daily for several weeks prior to the onset of the abdominal pain. The medication was given because of pain in the back which radiated into the leg and the left side, suggesting sciatica. The patient had complained of this pain for several years. Otherwise the past medical history was negative.

On admission to the hospital physical examination revealed an acutely ill, stuporous patient. The temperature was 103.4°, pulse 140, respiratory rate 40, blood pressure 176/90. The abdomen was considerably distended and tender, the tenderness being generalized. Muscle guarding and rebound tenderness were also present. Peristalsis, heard occasionally, was definitely decreased in frequency and intensity. No masses were palpable. Dullness and râles were heard over the left lower lobe of the chest posteriorly. Bilateral ankle edema was present. There were no other significant physical findings. The laboratory data on admission were: hemoglobin 84 per cent, white cell count 14,200, with 89 per cent neutrophils; BUN 22. A roentgen examination of the chest at this time revealed evidence of hypoventilation and bilateral basal bronchopneumonia.

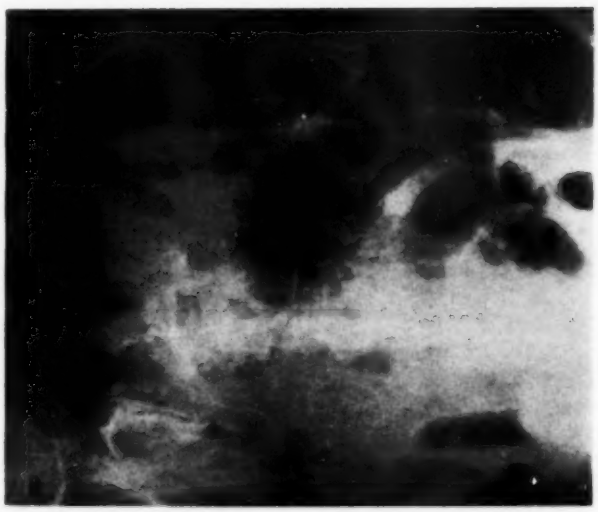


Case V. Roentgen examinations were made in the following positions: A. Supine. B. Erect.

CASE VI (J. M.)

A 68-year-old man was admitted to the hospital with an eight-hour history of severe abdominal pain of increasing intensity. During the period of the illness four dark bloody bowel movements were observed. There was no history of vomiting. The patient had been in an automobile accident two months previously and had suffered a fracture of the left acetabulum, for which he was hospitalized for one month. He was a known diabetic. He had had one previous operation, for repair of a hernia.

On admission the patient appeared to be in shock. The only recorded vital sign was the blood pressure, which was 30/0. Physical examination revealed a dyspneic, restless, disoriented male with cool, clammy skin and thready pulse. The abdomen was distended, with generalized tenderness throughout and no localizing signs. Peristalsis was not heard. Laboratory studies on admission showed: hemoglobin 15.8 gm.; white blood count 12,600; blood sugar 290; carbon dioxide of 41 volumes per cent.



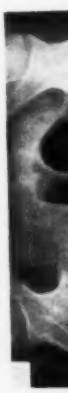
Case VI. Roentgen examinations were made in the following positions: A. Supine. B. Left lateral decubitus.

CASE VII (D. G.)

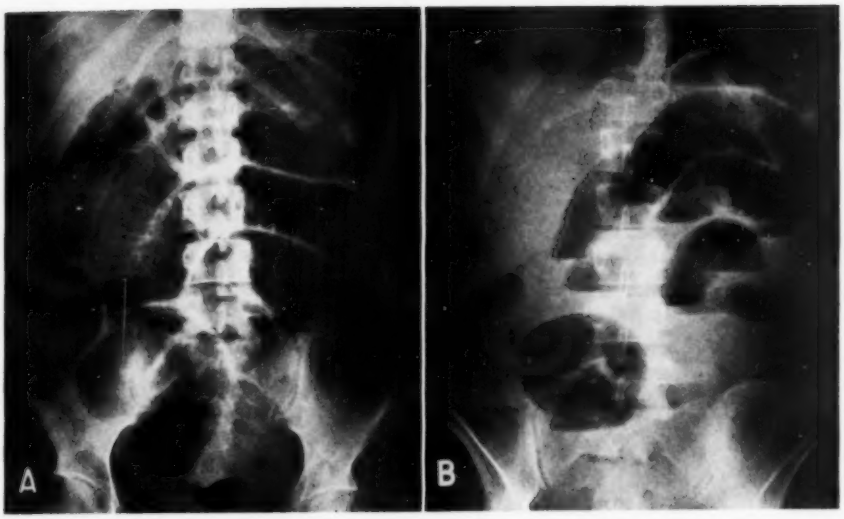
A 39-year-old female was admitted to the hospital with lower abdominal pain, distention, nausea, and vomiting of twenty-four hours duration. Pain was intermittent and occasionally crampy.

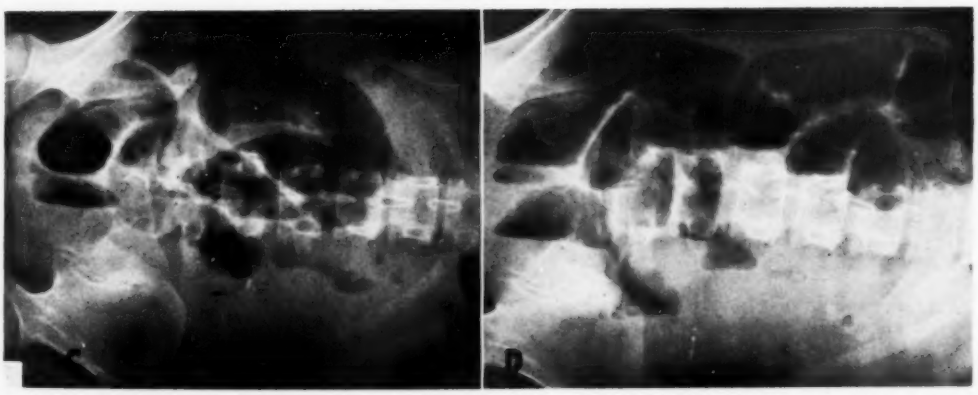
The past medical history was negative except for an appendectomy thirteen years previously.

On admission the patient was in moderate distress, with a pulse of 100, temperature 100°, and blood pressure 130/80. The abdomen was moderately distended and tympanitic. Intermittent high-pitched peristalsis was evident. No localized tenderness was elicited.



Case V





Case VII. Roentgen examinations were made in the following positions: A. Supine. B. Erect. C. Left lateral decubitus. D. Right lateral decubitus.

Bring this booklet with you to the meeting

Phoenix, Ariz., and Mary Blaske, secretary, V. A. Hospital, Phoenix, for their advice and help.

8011 N. 1st. Ave.
Phoenix, Ariz.

REFERENCES

ALBRIGHT, F., AND REIFENSTEIN, E. C., JR.: The Parathyroid Glands and Metabolic Bone Disease: Selected Studies. Baltimore, Williams & Wilkins Co., 1948, pp. 7, 216.

MILKMAN, L. A.: Multiple Spontaneous Idiopathic Symmetrical Fractures. Am. J. Roentgenol. **32**: 622–634, November 1934.

STEINBACH, H. L., KOLB, F. O., AND GILFILLAN, R.: A Mechanism of the Production of Pseudofractures in Osteomalacia (Milkman's Syndrome). Radiology **62**: 388–395, March 1954.

WINSTON, N. J., AND PENDERGRASS, E. P.: Milkman's Disease (Osteomalacia). Report of a Case Which Shows That Milkman's Disease May Be "Simple" Vitamin D Deficiency in Adults. Am. J. Roentgenol. **71**: 484–489, March 1954.

SUMARIO

Seudofracturas Costales de Milkman a Continuación de Taponamiento Extraperióstico con Ivalón

Dos casos de seudofracturas de Milkman fueron observados en tuberculosos pulmonares tratados con el taponamiento extraperióstico con Ivalón. En este procedimiento, se despega el periostio de las costillas, dejando que la pleura parietal y visceral caiga hacia adentro, creando allí un espacio extrapleural, que se llena con una substancia sintética llamada Ivalón. Esta se suele dejar en posición durante tres a cinco meses.

En estos casos, el tiempo transcurrido entre el tratamiento primitivo y el descubrimiento de las alteraciones óseas fué diez y once meses, respectivamente. Otros enfermos estudiados tras plazos más cortos no revelaron alteraciones roentgenológicas, aunque se encontraron defectos óseos macroscópicos al reoperar para retirar el taponamiento.

Las seudofracturas de Milkman parecen representar una fase de la atrofia ósea u osteomalacia, debida en este caso a la alteración de la nutrición vascular del hueso a consecuencia del despegamiento perióstico.

Osteochondritis Dissecans of the Talus[1]

W. L. DeGINDER, M.D.

OSTEOCHONDRITIS dissecans is an aseptic necrosis of subchondral bone and articular cartilage, correctly classified with the group of osteochondroses known by the eponyms Legg-Calvé-Perthes' disease, Köhler's disease, and Kienböck's disease. This specific type of lesion was recognized, described as an entity, and named long before the disease was sufficiently well defined to permit selection of an accurately descriptive term. The designation osteochondritis dissecans, first recommended by König in 1905 (4), inaccurately suggests an inflammatory pathogenesis, but prolonged popular use has given it universal acceptance.

Osteochondritis dissecans occurs most frequently in the weight-bearing joints which are most often subjected to trauma. The earliest reports refer to involvement of the femoral condyles of the knee, probably the most frequently traumatized articular surfaces. More recently, osteochondritis dissecans has been reported in many other sites. Although this form of osteochondrosis has a remarkably long history in medical literature, having been described first by Alexander Munro in 1738, there are relatively few reports of involvement of the talus, especially in English.

NEW CLINICAL MATERIAL

In the summer of 1951, the routine radiographic examinations of the occasional and inevitable training injuries in an Armored Division[2] revealed an unusual incidence of flake fractures and osteochondritis dissecans of the talus. A review of previous films of 482 injured ankles and follow-up radiographic examinations of 41 of these previously treated as sprains disclosed 10 cases of osteochondritis dissecans. All of these injuries had occurred within one year. Osteochondritis dissecans developed in 9 cases following ankle injuries resulting from one particular training exercise, commonly called "the running jump."

The running jump is a standard training device used by practically every military training unit. It usually involves jumping from an inclined ramp of heavy timber with a drop-off of about 10 feet to some sort of prepared landing area. The trainees approach the ramp at a fast trot, ascend the incline, and make a running jump from the end of the ramp toward the landing area, which may be packed earth, sawdust, or loose sand. The men are usually well conditioned by calisthenics, marching, and other exercises before they reach this phase of the training program. Combat boots are usually softened and conform well to the contours of feet and ankles by this time.

Several factors seem significant in this group of 10 cases of osteochondritis dissecans. All occurred as complications of jumping injuries involving a vertical drop of 9 or 10 feet. Nine of the injuries were sustained in the running jump exercise, and 1 in a voluntary leap of about 10 feet from the top of a truck. The landing area in each case was firm packed earth with an irregular surface. Eight of the men were of heavy build, weighing from 160 to 220 pounds. Eight of them had been engaged in light work or non-athletic school activities prior to induction into the army. It seemed that only one of these factors could be changed easily. The running jump exercise was modified by the addition of 1 foot of loose sand in the landing area, reducing the vertical drop to approximately 8 feet and providing a soft impact surface.

An attempt was made to obtain information concerning the occurrence of osteo-

[1] From the Veterans Hospital, Dallas, Texas. Accepted for publication in November 1954.
[2] Seventh Armored Division, Camp Roberts, Calif.

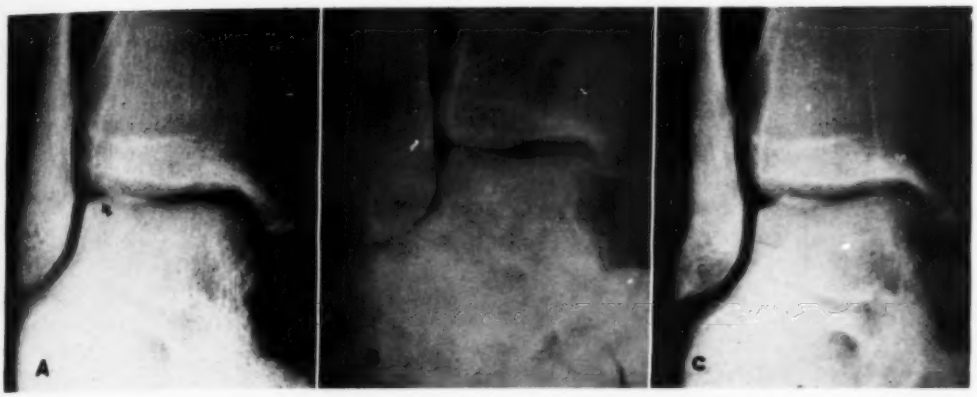


Fig. 1. Case 5. A. Radiograph, made immediately after a severe inversion injury of the ankle, reported as showing only soft-tissue swelling. No mention was made of the talus. After a week of rest and limited activities, the trainee resumed regular training duties.

B. After approximately six months, the soldier was re-examined because of severe pain beneath the lateral malleolus after a moderate amount of walking. There was no swelling of the ankle. The films revealed a distinct "button" of detached bone which was not displaced into the joint.

C. The joint was opened and the "button" was removed, along with the damaged overlying cartilage. Three months after the operation, the patient described "considerable improvement." It was not possible to reach him for further follow-up.

chondritis dissecans of the talus in other military establishments to serve as a control or basis of comparison of incidence following this specific type of injury. A review of the records of the Radiology and Orthopedic Services of two other army hospitals[3] for training units engaged in comparable activities disclosed a similar incidence of ankle injuries per 1,000 man-hours of training, but osteochondritis dissecans of the talus appeared to be much less common during corresponding twelve-month periods. It was clear that no valid statistical comparison could be devised for the incidence of osteochondritis dissecans in these three training units. The difference of indexing systems, lack of special emphasis in the other hospitals, and impossibility of special follow-up efforts certainly contributed to the lower number of recorded cases. The fact that both units are in a region of loose, sandy soil may or may not be significant.

Personal communications with radiologists at two military training commands situated in hard-earth terrain[4] disclosed a few additional cases of osteochondritis dissecans, but it appeared that even here it was considered a rare complication of ankle trauma. Analysis of data by means of Pearson's probabilty formula for three degrees of freedom shows less than 0.01 probability of chance occurrence of the amount of difference. This substantiates the impression that the incidence was unusual in the first group of injuries, but no comparison of ratios is attempted.

[3] At Camp Cooke, Calif., and Fort Ord, Calif.
[4] Camp Pendleton, Calif., and Fort Hood, Texas.

FOLLOW-UP PROGRAM

There is a distinct probability of late unsuspected development of osteochondritis dissecans in severe ankle injuries previously diagnosed and treated as sprains. The Radiology Service therefore attempted to obtain periodical follow-up radiographs of all ankles previously treated for sprains at this army hospital. The routine technic of radiographic examination was continued without any modification, and specialized procedures were avoided. This was felt to be justified for the following reasons:

1. The first portion of our studies of this disorder disclosed only one instance of talus injury overlooked on the initial examination (Fig. 1A). The routine was therefore considered adequate.

TABLE 1: ASEPTIC NECROSIS OF TALUS, INCLUDING OSTEOCHONDRITIS DISSECANS

Case Number	Age, Sex, Height, Weight, Occupation	Previous Physical Conditioning	Precipitating Trauma	Onset and Duration of Symptoms	Original Flake Fracture	Necrotic Fragment or Osteochondritis Dissecans Detected	Site of Lesion	Operation and Results
1*	19M, 68 in., 170 lb. Military training	High school	Sprain, jump injury	Mild, 1 year after injury	Doubtful	19 months	Left medial	.....
2*	21M, Military training	.....	Inversion, jump injury	Mild, intermittent	Yes	7 months	Right lateral	.....
3	19M, 70 in., 184 lb. Military training	High school	Inversion, jump injury	?	Yes	"Lost"	Right lateral	.....
4*	22M, 72 in., 180 lb. Military training	Office work	Sprain, jump injury	Mild, after exercise	No	8½ months	Left medial	.....
5	23M, 69 in., 200 lb. Military training	Office work	Inversion sprain, jump injury	Recurrence after 6 months	No	6 months	Right lateral	Yes Improved
6	20M, 66 in., 168 lb. Military training	Delivery truck driver	Inversion injury	3 months	Yes	3 months	Left lateral	No
7	19M, 67 in., 172 lb. Military training	High school	Eversion, jump from truck	Constant	No	7 months	Right lateral	.....
8	20M, 70 in., 185 lb. Military training	High school	Sprain, jump injury	Constant	Yes	3 months	Left lateral	.....
9*	66 in., 158 lb. Military training	Farm helper	Eversion of ankle, jump injury	Mild, 8 months. Continuous	Yes	8 months	Right medial	.....
10	22M, 72 in., 220 lb. Military training	Grocery clerk	Inversion, jump injury	Constant	No	4 months	Right lateral	Yes Improved
11	19M, 68 in., 177 lb. Military training	Athlete	Fell from cable bridge	Constant	Yes	5 months	Left lateral	Yes Improved
12	24M, 70 in., 191 lb. Military training	Farm helper	Fell from fire escape	Constant	Yes	3 months	Left lateral	.....
13	27M. Soldier	.....	Inversion jump injury	3 months	Yes	3 months	Right lateral	.....
14†	22M, 68 in., 164 lb. Soldier	.....	Sprain	?	No	5 months	Right medial	.....
15†	20M. Soldier	.....	Sprain	8 months	No	8 months	Right medial	.....
16†	19M, 72 in., 218 lb. Military training	Truck driver	Thrown from moving vehicle	5 weeks	Yes	"Lost"	Left lateral	.....
17†	25M. Marine	.....	Truck accident	?	Yes	"Lost"	Left lateral	.....
18	67F. Housewife	.....	Sprain	Several weeks duration. After 8 months without symptoms	Unknown	8 months	Left medial	Yes Improved
19‡	54M, 65 in., 140 lb. Hospital attendant	.....	Recurrent sprains	2 years, intermittent	Unknown	First examination 2 years after onset of pain	Left medial	No

* Four cases of late *unsuspected* osteochondritis dissecans of the talus detected through the follow-up program of re-examining all ankles previously treated as severe sprains. Camp Roberts Hospital.

† Cases located at other hospitals mentioned in footnotes. Only those cases with films and clinical histories have been included in the table. Five cases could not be confirmed.

‡ One case from Veterans Hospital, Dallas, Texas.

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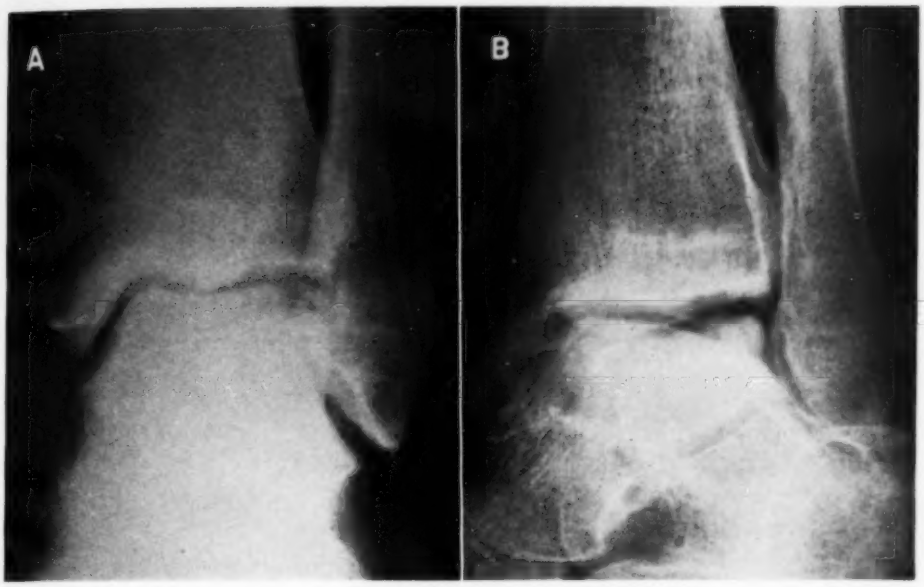

Fig. 2. Case 6. A. Inversion injury of the ankle produced a severe sprain, with extreme swelling about the lateral malleolus. In addition to this, there was a flake fracture of the superior lateral margin of the trochlea of the talus. The foot and ankle were immobilized eight weeks in a cast, after which the patient was assigned to non-strenuous duties for a time. At the end of approximately three months there was no sign of healing or improvement, and he was separated from the service. (Records gave no indication as to why there was no surgical treatment.)

B. After three years, a painful, barely usable ankle joint has resulted from the trauma of fragments of cartilage and bone detached from the site of the osteochondritis dissecans.

2. We hoped that continuation of the routine technic would permit statistical comparison of incidence in various hospitals using similar routines, whereas use of special technics might introduce another variable.

3. This plan would demonstrate whether or not small flake fractures and areas of early necrosis could be detected by routine technics, even with a field portable x-ray unit.

The follow-up program began with the review of 482 sets of radiographs of ankle injuries treated as severe sprains or fractures. Only 41 of these men were available for re-examination, most of them having been sent to Korea or Japan. Four cases of unsuspected osteochondritis dissecans were detected in this small group (Table I). In the subsequent study of 1,675 sprains and ankle injuries during the fifteen months following modification of the running jump exercise, 205 follow-up examinations were done. Only 3 new cases of osteochondritis dissecans of the talus were discovered. None of these new cases occurred as a result of the running jump exercise but all 3 cases involved some similar severe ankle injury (Table I).

Nothing would be accomplished by including every case history and every radiograph of the 19 cases reported. The significant common features are presented in Table I. Pertinent features in the illustrated cases are included in the captions.

DISCUSSION

In the cases we were able to follow, every flake fracture proceeded to the stage of aseptic necrosis (Figs. 2–4). The flake fractures usually occurred on the lateral margin of the talus, but two definite flake fractures of the medial margin were encountered (Fig. 6). Inversion injuries of the ankle were much more common than

Fig. 3. Case 13. A. Radiograph made immediately following a severe inversion injury sustained in jumping to the ground from a tank turret, showing a flake fracture on the lateral margin of the talus.
B. Radiograph made three months later showing the fragment free in the joint space. Eight weeks in a cast and walking cast, followed by four weeks of limited duty, failed to prevent detachment into the joint.

Fig. 4. Case 16. Anteroposterior projection of talus five weeks after ankle injuries sustained when the soldier was thrown from an ammunition trailer. Although the malleoli are intact, three separate bone chips have been separated from the talus. Note flake fracture of the superior lateral margin of the talus, already in the joint space. Records obtained from another hospital indicated that the lateral fragments united, but the flake fracture of the lateral joint margin became a necrotic loose-body.
Fig. 5. Case 1. Oblique projection showing necrotic button of bone to best advantage. This case of osteochondritis dissecans was detected in re-examination of an ankle that had been treated for severe sprain nineteen months previously. The soldier noted only mild pain and swelling after some unusually severe or prolonged activity.

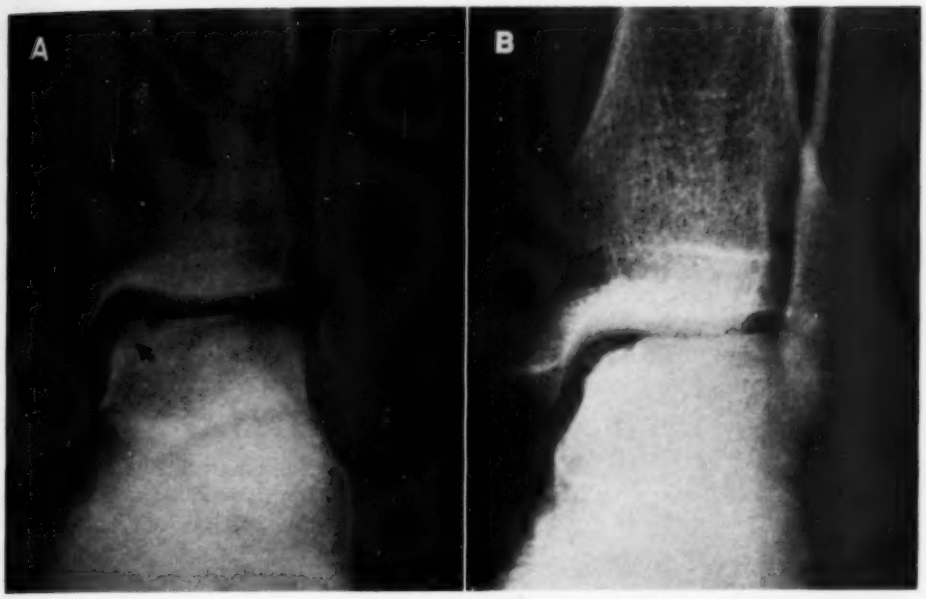

Fig. 6. Case 9. A. Small zone of compression and flake fracture of the *medial* margin of the talus sustained in a jump injury with eversion of the ankle. This flake is almost invisible in the reproduction, but quite clear in the original film.

B. Radiograph made eight months later, showing wide zone of mineral loss surrounding the necrotic "button" of bone. This zone measured 3 mm. on the original film. Only 2 cases of flake fracture of the medial malleolus were proved in this series, and follow-up films were not obtained on the second case.

eversion, but it is not possible to establish definite correlation between the type of trauma and the location of the chip fracture or osteochondritis of either the medial or lateral margin of the talus. The degree of primary injury appeared to have no definite bearing on the prognosis. In Case 5 (Fig. 1A) there appears to have been a minimal impaction of the margin, but the subsequent area of necrosis was small (Fig. 1B). In other cases without any visible impaction or chip fracture at the time of injury, the subsequent area of necrosis appeared larger (Fig. 7). In 1 case (Fig. 8) osteochondritis dissecans apparently followed repeated minor injuries of the joint margin rather than any single severe traumatic episode.

Surgical exploration for the removal of cartilage and bone fragments permitted certain observations. A severe injury may produce a flake fracture of the talus, particularly when there is forceful inversion of the foot with tearing of the lateral ligaments. The lateral margin of the trochlea of the talus suddenly impinges upon the flat articular surface of the lateral malleolus. This sometimes results in crushing of the articular cartilage and displacement of a flake of bone. Less forceful displacement produces a slight impaction or invisible primary damage. Aseptic necrosis of the separated bone fragment occurred in every case of flake fracture observed in our series. When no primary fracture of the margin could be detected, necrosis of subchondral bone apparently followed post-traumatic occlusion of the fine subcortical blood supply. Devascularization resulted in separation of a small meniscus of bone beneath the articular cartilage. The aseptic necrosis of bone is clearly visible in radiographs at this stage, although the articular cartilage may be intact and the condition asymptomatic. The necrotic bone is movable beneath the intact cartilage, but with its source of nutrient diffusion destroyed the overlying cartilage soon be-

Fig. 7. Case 18. A 67-year-old woman was referred for ankle radiographs (private practice) after swelling, pain, tenderness, and crepitation occurred about eight months following an almost forgotten sprain. The patient's daughter reminded her that the same ankle had been very painful and severely swollen after a fall down some steps eight months earlier. The "button" was removed, and the patient reported very definite subjective improvement within three weeks following the operation.

comes discolored, then roughened, and finally fragmented. A small fragment of dead bone may then escape into the joint. Most of the patients, even those with flake fractures of the talus, describe a brief period of improvement or complete remission of pain several weeks after the injury, but pain and limitation of motion recur when the cartilage necrosis begins. Chronic aching pain, tenderness over the anterior part of the ankle, and slight swelling of the ankle develop slowly. Effusion, crepitation, locking of the joint and painful weight-bearing indicate the development of traumatic arthrosis.

CONCLUSION

1. An unusual incidence of osteochondritis dissecans of the talus has been directly related to ankle injuries sustained in jumping injuries. In most of the cases cited, this involved a vertical drop of more than 9 feet and impact of landing on hard packed earth. Heavier men from non-strenuous pre-military occupations seemed most susceptible.

2. A follow-up program with routine radiographic technics proved that such procedures permit detection of osteochondritis dissecans before traumatic arthrosis develops. It also demonstrated that osteochondritis dissecans occurs in ankles previously treated for severe sprains, and that the complication may remain undetected until severe joint damage has occurred.

3. Aseptic necrosis of separated bone fragments occurred in every case of flake fracture of the talus observed in this series.

4. When an injured ankle is first seen, it deserves added examination followed by correct treatment. Correct treatment cannot follow an incorrect or inadequate examination. A reasonably thorough routine radiographic examination constitutes an essential part of the physical examination of an injured ankle. The minimal routine should include anteroposterior, lateral, and at least an internal oblique view of the talus.

5. Only the most minor ankle injuries are safely treated by passive support by tape or elastic bandage with immediate resumption of activity. All others should be provided with protective immobilization and sufficient rest to permit healing and provide opportunity for observation of progress. Injection of procaine and resumption of activity are likely to promote unwarranted satisfaction on the part of the patient and a false feeling of accomplishment on the part of the physician, both decreasing the probability of proper treatment and follow-up.

Fig. 8. Case 19. A. A 54-year-old man complained of chronic aching pain, swelling, tenderness, and occasional "grating sensation," with remission and exacerbation over a two-year period. He recalled many mild inversion injuries of the ankle, followed by pain and swelling, but could cite no single severe injury. The irregular zone of mineral loss is rather indistinct on the medial margin of the talus.

B. Quasi-lateral view revealing the "button" more clearly, although detached bone fragments were seen to best advantage in the anteroposterior or oblique projections in all but 2 cases. There is no visible traumatic arthritis at this time, but the patient has refused surgical excision, and progressive joint damage is to be expected.

6. When a sprained ankle at rest fails to show very rapid healing within ten days, follow-up radiographs may reveal small impactions or flake fractures that were invisible prior to the physiological calcium absorption along the line of crushed and broken trabeculae. It is conceivable (but not proved) that prolonged rest at this stage might permit primary healing in some of these cases that otherwise would proceed to aseptic necrosis.

7. Any patient who complains of recurrence of pain after a relatively asymptomatic period of two or three months after treatment of a sprain should be reexamined to confirm or exclude the presence of osteochondritis dissecans of the talus. A follow-up examination two or three months after injury might be worth while in any patient who has suffered a severe ankle injury in an auto wreck, jump, or fall, where a strong downward driving force is coupled with inversion or eversion of the ankle.

8. Radiographic diagnosis should be made before early necrosis and roughening of the articular cartilage become evident. Orthopedic treatment at this stage can prevent the progressive traumatic arthrosis that is certain to occur if loose bodies are allowed to remain in this weight-bearing joint.

ACKNOWLEDGMENT: The author wishes to express his gratitude and appreciation to the public information officers, hospital commanders, radiologists, and others who assisted in the accumulation of this material and authorized its release for publication.

4500 S. Lancaster Rd.
Dallas 2, Texas

REFERENCES

1. COBEY, M. C.: Osteochondritis Dissecans of the Astragalus. Mil. Surgeon **93**: 184–186, August 1943.

2. COLTART, W. D.: "Aviator's Astragalus." J. Bone & Joint Surg. **34-B**: 545–566, November 1952.

3. CONWAY, F. N.: Osteochondritis Dissecans. A Description of the Stages of the Condition and Its Probable Traumatic Etiology. Am. J. Surg. **38**: 691–699, December 1937.

4. KÖNIG, F.: Osteochondritis Dissecans. Zentralbl. f. Chir. **32**: 809, 1905. Cited by Vaughan and Stapleton (9).

5. MARKS, K. L.: Flake Fracture of the Talus Progressing to Osteochondritis Dissecans. J. Bone & Joint Surg. **34-B**: 90–92, February 1952.

6. NEGRE, B.: Bilateral Dissecting Osteochondritis of the Astragalus. J. radiol. et électrol. **34**: 592, 1953.

7. PROTAR, M., AND HUSSON, J.: Three Cases of Osteochondritis Dissecans of the Astragalus. J. radiol et électrol. **33**: 421, 1952.

8. RAY, R. B., AND COUGHLIN, E. J., Jr.: Osteochondritis Dissecans of the Talus. J. Bone & Joint Surg. **29**: 697–706, July 1947.

9. VAUGHAN, C. E., AND STAPLETON, J. G.: Osteochondritis Dissecans of the Ankle, with Reports of Four Proved Cases. Radiology **49**: 72–79, July 1947.

SUMARIO

Osteocondritis del Astrágalo

El sistemático examen radiográfico de las lesiones experimentadas durante el adiestramiento en una unidad militar reveló una incidencia extraordinariamente alta de fracturas astilladas y osteocondritis disecante. El repaso de las radiografías de 482 tobillos lesionados y los exámenes subsiguientes de 41 de ellos, que habían sido tratados antes como esguinces, reveló 10 casos de osteocondritis disecante. En 9 de estos casos, la lesión era el resultado inmediato de un salto corriendo, desde unos 3 metros de altura. La mayor parte de los enfermos eran sujetos de mucho peso, que antes de ingresar en el ejército, se habían dedicado a tareas ligeras sin relación con el atletismo.

La continuación de la observación de los 41 casos reveló 4 casos de osteocondritis insospechada antes y en 205 exámenes de observación subsiguiente se descubrieron 3 casos más. En todos los casos de fractura astillada observados, había necrosis aséptica de los fragmentos óseos separados.

Recálcase la importancia del examen y del tratamiento adecuados de las lesiones de los tobillos. Cuando un tobillo torcido y sometido al descanso no muestra rápida mejoría, las radiografías subsecuentes pueden revelar pequeñas compresiones o fracturas astilladas que eran antes invisibles.

El examen radiográfico sistemático permite descubrir la osteocondritis antes de la aparición de artrosis traumática.

Tabúlanse los detalles de 19 casos.

Testicular Cancer: Management of Metastases, with Report of a New Chemotherapeutic Agent[1]

ORLISS WILDERMUTH, M.D.

POSTORCHIECTOMY abdominal irradiation for testicular cancer has become a well established procedure during the last decade. While this is not a common neoplasm, 99 cases have been seen since 1935 at the Tumor Institute of the Swedish Hospital of Seattle (Table I). Of this number, 22 were untreated. Beside 10 seen in consultation, 6 were moribund, in 3 instances even beyond biopsy, and in general susceptible only to pharmacological palliation. Three were seen with widespread metastases, while 2 others refused treatment on religious grounds.

TABLE I: NINETY-NINE CASES OF TESTICULAR TUMOR

Diagnosis	
Seminoma	43
Embryonal-cell cancer	41
Teratoma	8
Adenocarcinoma	2
Choriocarcinoma	1
Dermoid	1
No biopsy	3
Untreated	
Seen in consultation	10
Emaciated (3 no biopsy)	6
Generalized metastases	3
Treatment refused	2
Dermoid	1
TOTAL	22
Treated	
Prophylactic	44
Seminoma	23
Embryonal-cell cancer	16
Miscellaneous	5
With metastases	33
Seminoma	13
Embryonal-cell cancer	17
Miscellaneous	3

The treated cases fall into two groups: those treated prior to 1946 and those seen subsequently (Table II). In the earlier period the practice was orchiectomy, with irradiation only for recurrences and metastases. The more recent picture is good, as cancer goes. The favorable results recorded by Friedman and Moore (1), Milton Friedman (2), and others (3) have influenced our surgeons, since 1946, to call for intensive postoperative irradiation even when no clinical evidence of metastasis could be found. As indicated in Table III, the results of combined surgical and radiological management have supported Friedman's 85 per cent control dictum (2). No correlation between tunica vaginalis or blood vessel invasion and control could be established in this material. Control in embryonal-cell carcinoma and seminoma was essentially the same. In this connection it is to be noted that our material included an unusually high percentage of tumors called embryonal-cell carcinoma as compared to the Army statistics (4), our figure being similar to that of Kaplan *et al.* (5).

TABLE II: IRRADIATION IN SEVENTY-SEVEN CASES OF TESTICULAR TUMOR

Date of Treatment	Without Metastases	With Metastases
Before 1946	11 (31.4%)	24 (68.6%)
After 1946	37 (88.0%)	5 (12.0%)

For the unfortunate patient with metastases clinically evident at the time of discovery of a primary tumor of the testis, the outlook is grim. But, though grim, it is not hopeless, as evidenced by the 3 cures shown in Table III and by the response of many more to multiple therapeutic procedures, with a gain of months or even years of useful life. As physicians, we are charged with the rehabilitation and care of these patients for varying periods of survival. The seminoma patient whose chest roentgenograms are seen in Figure 1 had a large tumor, a 30-pound weight loss, and an abdominal mass 18 cm. in diameter at the level of the renal pedicle. The abdominal mass responded so well to irradia-

[1] From the Tumor Institute of the Swedish Hospital, Seattle, Wash. Presented at the Fortieth Annual Meeting of the Radiological Society of North America, Los Angeles, Calif., Dec. 5–10, 1954.

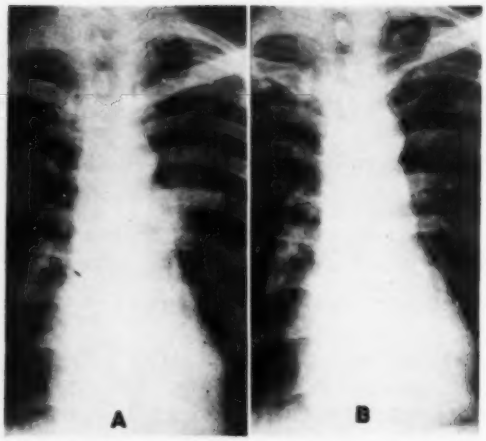

Fig. 1. A. Mediastinal mass, December 1944, which received a tumor dose of 2,000 r in twenty-one days, with prompt and complete reduction.
B. Same case. December 1953, after nine years of asymptomatic, useful life and no further metastases.

TABLE III: RESULTS OF POSTOPERATIVE IRRADIATION

Tumor	Without Metastases		With Metastases	
	Number	Controlled	Number	Controlled
Seminoma	23	19	13	1
Embryonal-cell cancer	16	14	17	1
Miscellaneous	5	4	3	1
	44	37 (84%)	33	3 (8.3%)

tion in 1943 that the pelvic fields were treated. In 1944, a mediastinal mass became evident (Fig. 1A) and this was also treated. Since that time the patient has remained disease-free for nine years (Fig. 1B). In another patient with teratoma of the testis and positive inguinal nodes at surgery, an iliac mass palpable above the inguinal ligament following orchiectomy disappeared after 5,000 r irradiation. His subsequent survival for fourteen years includes a tour of mine-sweeping duty along the China coast during World War II.

In the management of the patient with metastases, surprisingly long periods of useful living can be obtained by persistent observation and irradiation judiciously applied wherever the disease is discovered. For example, one seminoma patient, when seen in 1947 for postoperative irradiation, had an established pain pattern of short duration involving the left sacroiliac joint and sciatic nerve. Although no mass could be demonstrated, relief was obtained through irradiation therapy to the left pelvis. Eight months later, a left upper abdominal mass, measuring 6 cm., was irradiated, with prompt regression. The

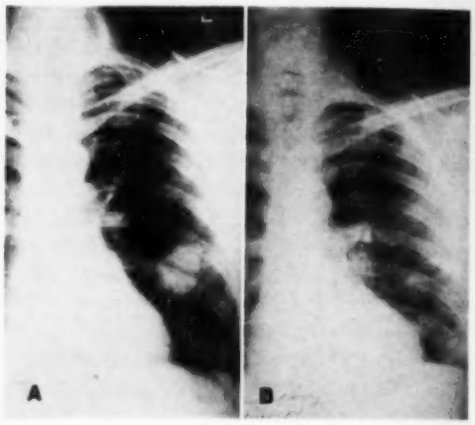

Fig. 2. A. Solitary mass (October 1953) prior to 2,800 r tumor dose in twenty days. By March 1954, the chest was completely clear.
B. Recurrence suspected in August and definite by November 1954, one year after treatment, during which interval the patient was asymptomatic.

patient became debilitated and unable to work late in 1950, seven months before death from massive liver involvement in June 1951. This represents a total of four years of useful survival, until the last seven months.

In the case shown in Figure 2A a solitary lung metastasis developed ten months after combined primary treatment for seminoma. The pulmonary tumor responded well to irradiation for eleven months of useful life and full occupation, only to recur (Fig. 2B). At lobectomy, eighteen months after the original discovery of the metastasis, no evidence of other spread was discovered. This case demonstrates the necessity of combined efforts of surgery and irradiation in the management of metastases as well as in the primary attack.

Little has been available to the patient with disseminated metastases beyond oc-

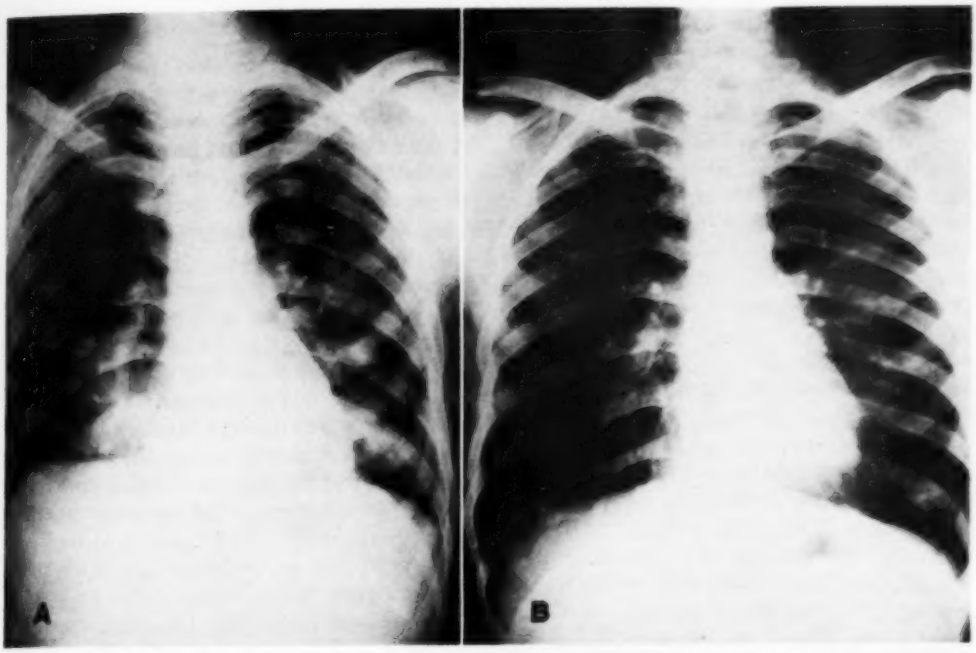

Fig. 3. A. Widespread hematogenous lung metastases September 1953, considered to be beyond salvage or palliation by irradiation. Note the large bilateral gynecomastia.

B. Resolution of metastases, December 1953, after treatment with Nitrofurazone, 49 gm. in four weeks, followed by three weeks rest because of toxic neuritis.

C. Despite the persistent scars (?) or disease persisting unchanged, Jan. 31, 1955, the patient lives actively without disability or treatment of any kind.

casional transient relief with x-rays or nitrogen mustards. However, by the time the roentgenogram reproduced in Figure 3A was obtained, Nitrofurazone was available. Although the drug had not been tolerated by our first patient, the present subject was able to take 1.5 gm. a day. In August 1953, he had completed a course of postorchiectomy irradiation totaling 3,500 r in fifty days (minimum dose) throughout the midabdomen and pelvis. He was originally considered free of chest metastases, but restudy of the pretreatment films demonstrated early involvement at the sites obvious in Figure 3A. After two weeks, during which he received 21 gm. of Nitrofurazone, there was a general systemic improvement, with softening of painful bilateral gynecomastia. The dosage of the drug was increased to 2 gm. daily. On Nov. 26, two weeks and 28 gm. later, severely painful peripheral neuropathy terminated the medication and supportive therapy was instituted. Within three weeks the neuritis improved slightly, but the chest film (Fig. 3B) showed so much improvement that the drug was started again at 1.5 gm. a day. A week later the patient required hospitalization for un-

bearable pain in the extremities. After a month of narcotics, supportive therapy, and finally nerve blocks, he was ready for discharge. Two months later, he was back at work for a full eight-hour day. His last roentgenogram (Fig. 3C) continues free of evidence of recurrence. His strength and weight have increased (20 lb.) and he is without clinical evidence of other metastases. More important, he has gained one and one-half years of useful, enjoyable life.

Nitrofurazone (NNR)[2] is better known in the form of the liquid skin antiseptic, "Furacin." Urologists are acquainted with another member of the same family of drugs, Furadantin, a urinary antiseptic which, when used internally, was observed to produce testicular atrophy. Experimentally, the atrophy was found, in both animals and man, to be due to disintegration of the seminiferous epithelium (7, 8). It was this effect that led to a trial of the drug in tumors of the testicle originating in the seminiferous epithelium.

Since regeneration of the seminiferous epithelium was observed at the bactericidal dose level in urological practice (8), the total amount of the drug in cancer patients was determined by the tolerance of the subject. The daily dose was sufficient to produce grossly stained urine. At such levels, vomiting was found to occur less often with enteric coated tablets, both in our patients and those of Hasen and Moore (6). Toxic neuritis was frequently noted by urologists (6). In our patients, this incapacitating complication determines the total dose of the drug. It resembles the peripheral neuritis of severe, uncontrolled diabetes or pernicious anemia. The mechanism of action of the chemical is postulated to occur at the metabolic level of cellular respiration. In bacterial studies, it is demonstrated to interfere with oxidation of glucose and peruviate (9).

[2] Supplied by Eaton Laboratories, Inc., Norwich, N. Y.

SUMMARY AND CONCLUSION

Thirty-three of 99 patients seen with testicular neoplasm had demonstrable metastases at the onset of irradiation therapy. A cure rate of 8.3 per cent in this group forms a dismal backdrop for the more satisfactory 84 per cent control of patients who had no demonstrable metastases at the time of irradiation. The recent trend to management by a combination of surgery and irradiation insures a continuation of the favorable statistics.

The radiologist is often first to observe the follow-up chest film blotched with disseminated metastases of testicular cancer. The purpose of this report is to call his attention to Nitrofurazone and its destructive effect on the seminiferous epithelium. The ablation of all metastases in one patient, with the re-establishment of healthy, useful living, is reported. This case history demonstrates that the drug can add months and perhaps years to the useful life span of the patient otherwise doomed.

Department of Radiology
Ohio State University Hospital
Columbus 10, Ohio

REFERENCES

1. FRIEDMAN, N. B., AND MOORE, R. A.: Tumors of the Testis: Report on 922 Cases. Mil. Surgeon **99:** 573–593, November 1946.

2. FRIEDMAN, MILTON: On Tumors of the Testis and Their Treatment. In Clinical Therapeutic Radiology, edited by U. V. Portmann. New York, Thomas Nelson & Sons, 1950, pp. 276–308.

3. PENDERGRASS, E. P., CHAMBERLIN, G. W., SELMAN, J., AND HORN, R. C., JR.: Management of Malignant Tumors of the Testis. Am. J. Roentgenol. **55:** 555–574, May 1946.

4. DIXON, F. J., AND MOORE, R. A.: Testicular Tumors. A Clinicopathological Study. Cancer **6:** 426–454, May 1953.

5. KAPLAN, G., COHEN, B. B., AND ROSWIT, B.: Malignant Testicular Tumors: Clinical and Therapeutic Evaluation of 158 Cases. Am. J. Roentgenol. **66:** 405–419, September 1951.

6. HASEN, H. B., AND MOORE, T. D.: Nitrofurantoin. A Study in Vitro and in Vivo in One Hundred Cases of Urinary Infection. J.A.M.A. **155:** 1470–1473, Aug. 21, 1954.

7. PRIOR, J. T., AND FERGUSON, J. H.: Cytotoxic Effects of a Nitrofuran on Rat Testis. Cancer **3:** 1062–1072, November 1950.

8. FRIEDGOOD, C. E., AND RIPSTEIN, C. B.: The Effect of Nitrofurazone on Tumors of the Human Testis and Prostate Gland. Unpublished.

9. GREEN, M. N.: The Effect of Furacin (5-Nitro-2-Furaldehyde Semicarbazone) on Metabolism of Bacteria. Arch. Biochem. **19:** 397–406, December 1948.

SUMARIO

Cáncer Testicular: Asistencia de las Metástasis con Informe sobre un Nuevo Agente Quimioterapéutico

Aunque los tumores malignos del testículo no son frecuentes, en el Instituto de Tumores del Hospital Sueco de Seattle, Wásh., E. U. A., se observaron 99 casos de 1935 a 1954, tratándose a 77 de ellos. Antes de 1948, se reservaba la irradiación en su mayor parte para el tratamiento de las recurrencias y las metástasis. La práctica más reciente es seguir la orquiectomía con la irradiación en todos los casos, aunque no haya signos clínicos de metástasis. Los resultados del tratamiento combinado han justificado ese sistema. Para toda la serie, el coeficiente de dominio fué de 8.3 por ciento en los que tenían metástasis observables cuando se instituía la radioterapia y de 84 por ciento para los que no tenían metástasis.

En la asistencia de los enfermos que tienen metástasis puede prolongarse bastante la vida útil mediante la observación persistente y la irradiación juiciosa a medida que ésta se vuelve necesaria. Para los casos con metástasis generalizadas, la Nitrofurazone, mejor conocida en su forma de Furacin, ha proporcionado paliación prolongada. Esta droga ejerce un efecto destructor sobre el epitelio seminífero, y puede producir una neuritis tóxica.

EDITORIAL

Medical Electronics, a Rapidly Expanding Field

Of all medical specialists, the radiologist undoubtedly is most concerned with electronics. His interest developed originally because a special type of electron tube—the x-ray tube—formed the basic component of his specialty. The recent introduction of electronic x-ray control devices and image intensifiers has emphasized for him the importance of this field. A large number of electronic technics have not been applied to medical problems because the exchange of information between physicians and electronic engineers has been inadequate. Electronic engineers should be aware of the medical problems in which electronics can be of help and members of the medical profession should know where and how to present their problems to the engineers. There are in existence two engineering groups—the Committee on Electrical Techniques in Medicine and Biology and the Professional Group on Medical Electronics[1]—whose *raison d'être* is to facilitate this doctor-engineer communication. It is the purpose of this editorial to present some information concerning these groups and their activities.

About 1932 the American Institute of Electrical Engineers formally recognized the importance of using electrical technics in medicine by sponsoring a discussion on electromedical problems. The interest aroused by this discussion resulted in a national Annual Conference on Electrical Techniques in Medicine and Biology under the joint sponsorship of the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Instrument Society of America. E. Dale Trout has been Program Chairman of the Conference for several years. At the Seventh Annual Meeting, in 1954, an entire session was devoted to the subject of x-rays and instrumentation. Dr. J. W. J. Carpender, Department of Radiology, University of Chicago, was Chairman of this session, at which a paper was presented by Russell H. Morgan and Ralph Sturm on "The Electronic Fluoroscope of the Television Type." Two other papers of interest to radiologists were read: "Progress Report on Cinefluorography Using Image Brightness Intensification" and "Xerography." The Eighth Annual Conference, to be held in Washington, D. C., in November 1955, will feature a session on instrumentation for angiocardiography.

In 1952 the Professional Group on Medical Electronics was formed by the Institute of Radio Engineers, the national professional organization of electronic engineers. This group is one of the twenty-three professional groups within the framework of the parent organization. Each group represents a field of special interest, somewhat analogous to a medical "specialty." The Professional Group on Medical Electronics is concerned with the application of electronic technics to medical problems, and now has among its more than 1,500 members electronic engineers, physicians, biologists, and physicists.

Radiologists have participated in the programs of at least two medical electronic group chapters. Some of the work on stereocinefluorography which is being done in the Department of Radiology, University of Rochester, was presented by members of Dr. Ramsey's group for the Rochester, N. Y., Chapter. The San Francisco Chapter has had the help of four radiologists. Dr. Earl R. Miller discussed "X-ray Movies" and "X-ray Microscopy and Its Medical Application"; Dr. Sydney F. Thomas talked on the "Diagnostic Use

of Radioactive Isotopes in Medicine"; Dr. Robert S. Stone discussed some aspects of "Problems in Dose Measurement of High Energy Radiation"; and Dr. Robert R. Newell, who can always be counted on to start a lively discussion, presented "Medical Applications of the Linear-Electron Accelerator." The exchange of information has been particularly brisk at these meetings because an electronic engineer and a radiologist have shared the platform. The engineer has presented technical electronic details and the doctor has discussed the medical use of the electronic device.

The Annual Conference on Electrical Techniques in Medicine and Biology and the meetings of the Professional Group on Medical Electronics are good sources of information on the use of electronic devices in medicine. These meetings may also help the physician to find an electronics expert to work on his instrumentation problem.

The radiologist is urged to take advantage of the Annual Conference and the Medical Electronics Group meetings to discuss his electronic instrumentation problems, for among the eager listeners he is certain to find an engineer who would like to work with him or who may already know a solution.

LEE B. LUSTED, M.D.

[1] Further information on these groups can be obtained by addressing *Committee on Electrical Techniques in Medicine and Biology*, W. S. Lusby, Secretary, Westinghouse X-ray Division, 2519 Wilkens Ave., Baltimore 3, Md., and *Professional Group on Medical Electronics*, Wilson Greatbatch, Secretary, University of Buffalo School of Engineering, The University Campus, Buffalo 14, N. Y.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

FORTY-FIRST ANNUAL MEETING

Palmer House, Chicago, Ill., Dec. 12–16, 1955

PRELIMINARY PROGRAM

Monday, December 12

OPENING SESSION: 10:30 A.M.–12:00 M.

SECTION A

Howard B. Hunt, M.D., First Vice-President, Presiding

Call to Order.

Greetings. TOM B. BOND, M.D., President, Radiological Society of North America

President's Address. TOM B. BOND, M.D.

College Report on Present Status of Blue Cross and Blue Shield. WARREN W. FUREY, M.D.

Radiation Control Legislation. LAURISTON S. TAYLOR, A.B.

SECTION AB: 2:00–4:00 P.M.

Clarence E. Hufford, M.D., President-Elect, Presiding

Comparative Radiotherapeutic Results in Carcinoma of the Endometrium as Modified by Prior Surgery and Radiation. HOWARD B. HUNT, M.D.

Hemoptysis Panel. RAYMOND R. LANIER, M.D., *Moderator;* O. T. CLAGETT, M.D., BOB EBERT, M.D., FRED J. HODGES, M.D., WILLIAM O. UMIKER, M.D.

BUSINESS MEETING: 4:30 P.M.

COUNSELORS' DINNER: 7:00 P.M.

Tuesday, December 13

SECTION A: 10:30 A.M.–12:10 P.M.

Charles M. Gray, M.D., Second Vice-President, Presiding

Comparison of Nitrogen Mustard and Radioactive Colloidal Gold in the Treatment of Serous Effusions of Neoplastic Origin. FREDERICK J. BONTE, M.D., J. P. STORAASLI, M.D., AUSTIN M. WEISBERGER, M.D.

Evaluation of Routine Skull Films in Intracranial Meningiomas. TED F. LEIGH, M.D., EDGAR F. FINCHER, M.D., MAXWELL F. HALL, JR., M.D.

Hysterography in Cancer of the Uterus. DR. OLOF NORMAN, Lund, Sweden.

Cobalt-60 Beam Therapy: Two Years Experience at Montefiore Hospital (New York). JACOB R. FREID, M.D.

Colloid Cyst of the Third Ventricle. HARRY HAUSER, M.D.

SECTION B: 10:30 A.M.–12:00 M.

CIVIL DEFENSE

Lauriston S. Taylor, A.B., Presiding

Biological Effectiveness of Nuclear Radiations from Fission Weapons. *PAYNE S. HARRIS, M.D., G. S. HURST, M.S., S. C. SIGOLOFF.

Response of Human Beings Accidentally Exposed to Fallout Radiation from a Thermonuclear Explosion. *E. P. CRONKITE, M.D., ET AL.

Criteria for Evaluating Gamma Radiation Exposures from Fallout Following Nuclear Detonations. GORDON M. DUNNING.

Residual Radiation in Civil Defense. EDWIN G. WILLIAMS, M.D.

Permissible Exposure for Civil Defense Workers and Evacuees under Emergency Conditions. LAURISTON S. TAYLOR, A.B.

SECTION AB: 2:00–4:00 P.M.

Theodore J. Wachowski, M.D., Presiding

Cushing Disease: The Roentgenographic Findings. LAURENCE L. ROBBINS, M.D.

Breast Panel: Curative Treatment of Cancer of the Breast. DONALD S. CHILDS, JR., M.D., *Moderator;* JOHN M. DORSEY, M.D., MALCOLM B. DOCKERTY, M.D., PETER RUSSO, M.D., VINCENT COLLINS, M.D.

BUSINESS MEETING: 4:30 P.M.

THE CARMAN LECTURE: 8:30 P.M.

Axel Norman Arneson, M.D.

Wednesday, December 14

SECTION A: 10:30 A.M.–12:10 P.M.

C. Edgar Virden, M.D., Presiding

Renografin, Hypaque and Urokon: A Comparative Clinical Trial of Urographic Media. WILLIAM R. EYLER, M.D., A. WAITE BOHNE, M.D., DALE R. DREW, M.D.

The Development of a Chest Phantom for Use in Radiologic Dosimetry. JOHN H. HARRIS, JR., M.D., WILLIAM J. TUDDENHAM, M.D., LEONARD STANTON, M.S., FRANK GLAUSER, M.D.

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* Will present paper.

Immediate and Continuous Uptake Studies of I-131 in Diagnosis and Treatment of Hyperthyroidism. SOL TAPLITS, M.D., ARCHIE FINE, M.D., LEE S. ROSENBERG, M.D.

Iodine-Containing Media Used in Cerebral Angiography. J. E. WHITELEATHER, M.D.

Some Practical Adjunctive Measures in Handling of Interstitial Cobalt-60. I. MESCHAN, M.D.

SECTION B: 10:30 A.M.–12:00 M.

RELATIVE BIOLOGICAL EFFECTIVENESS

Titus C. Evans, Ph.D., Presiding

RBE of Heavy Particles from $B^{10}(n,\alpha)Li^7$ Reaction for Acute Effects in the Mouse. *V. P. BOND, M.D., O. D. EASTERDAY, Ph.D., E. E. STICKLEY, Ph.D., J. S. ROBERTSON, M.D.

Studies of RBE of Neutrons, X-rays, and Gamma Rays for Cataract Induction. *A. C. UPTON, M.D., K. W. CHRISTENBERRY, M.D., G. S. MELVILLE, Ph.D.

The RBE of Supervoltage X-rays. *H. I. KOHN, M.D., SHIRLEY GUNTER, Ph.D., R. F. KALLMAN, Ph.D.

The RBE of Some Internal Emitters. MIRIAM P. FINKEL, Ph.D.

RBE of Neutrons in Production of Cataracts. E. F. RILEY, Ph.D., P. J. LEINFELDER, M.D., *T. C. EVANS, Ph.D., R. B. RHODY, Ph.D.

SECTION AB: 2:00–5:10 P.M.

Laurence L. Robbins, M.D., Presiding

Carcinoma of the Posterior Tongue Treated with Radiation. CHARLES L. MARTIN, M.D., and JAMES A. MARTIN, M.D.

Acute Abdomen Panel. PHILIP J. HODES, M.D., *Moderator;* LEO G. RIGLER, M.D., I. S. RAVDIN, M.D.

A Simplified Method of Interpreting and Calculating Integral Dose in Radiotherapeutic Practice. R. KENNETH LOEFFLER, M.D.

Congenital Arteriovenous Fistulae of the Peripheral Circulation as Exhibited Roentgenologically. ALEXANDER MARGULIS, M.D., and THOMAS MURPHY, M.D.

SECTION C: 2:00–5:00 P.M.

RECENT ADVANCES IN RADIOLOGIC PHYSICS

Harold O. Wyckoff, PH.D., Presiding

(Titles not available until annual meeting)

Thursday, December 15

SECTION A: 10:30 A.M.–12:00 M.

Sydney F. Thomas, M.D., Third Vice-President, Presiding

Spondylolisthesis. PALMER E. WIGBY, M.D.

Practical Evaluation of Image Intensification. JARRELL E. MILLER, M.D.

Roentgen Manifestations of Pulmonary Hypertension in Congenital Heart Disease. THEODORE E. KEATS, M.D., VAN ALLEN KREIS, M.D., ELLEN SIMPSON, M.D.

Gas Embolism: Some Considerations of Importance in Diagnostic Roentgenology, Including the Experimental Use of Carbon Dioxide as an Intracardiac Contrast Material. HERBERT M. STAUFFER, M.D., THOMAS M. DURANT, M.D., M. J. OPPENHEIMER, M.D.

Value of Radiation Therapy in the Management of Glioma of the Optic Nerves and Chiasm. ERNEST H. WOOD, M.D., JUAN TAVERAS, M.D., LESTER MOUNT, M.D.

SECTION B: 10:30 A.M.–12:10 P.M.

APPARATUS AND INSTRUMENTATION

Harold O. Wyckoff, Ph.D., Presiding

Physical Aspects of Electron Therapy for Superficial Disease. K. A. WRIGHT, B. A., *R. C. GRANKE, S.B., J. G. TRUMP, D.Sc.

A High-Contrast Photographic Recorder for Scintillation Scanning. *D. E. KUHL, M.D., R. H. CHAMBERLAIN, M.D., J. HALE, M.S., R. O. GORSON, M.S.

Current Technics in Handling and Distributing Cobalt-60 Radiation Sources. A. B. LILLIE, Ph.D.

The Use of the Ferrous Sulfate Dosimeter to Measure Integral Dose. *M. L. MEURK, B.A., J. W. ZSULA, B.S., J. S. LAUGHLIN, Ph.D.

Design Criteria of Free-Air Chambers for 250- to 500-kv X-rays. *H. O. WYCKOFF, Ph.D., and F. S. KIRN, M.A.

SECTION AB: 2:00–4:00 P.M.

Sydney J. Hawley, M.D., Presiding

Hip Disease in Children. WAYNE A. SIMRIL, M.D.

Symposium on Supervoltage. J. W. J. CARPENDER, M.D., *Moderator;* S. T. CANTRIL, M.D., MILTON FRIEDMAN, M.D., RUTH GUTTMANN, M.D., T. A. WATSON, M.B., Ch.B.

BUSINESS MEETING: 4:30 P.M.

ANNUAL BANQUET: 8:00 P.M.

Friday, December 16

SECTION A: 10:30 A.M.–12:50 P.M.

Elbert K. Lewis, M.D., Presiding

Grid Therapy in Extensive Head and Neck Cancer. JOHN F. DILLON, M.D., and GILBERT H. FLETCHER, M.D.

* Will present paper.

* Will present paper.

Irradiation and Surgery in the Management of Carcinoma of the Uterine Cervix. FREDERICK W. O'BRIEN, JR., M.D.

The Use of Adjuvants with Barium Sulfate in the Visualization of the Gastric Mucosa. EVERETT L. PIRKEY, M.D., PETER K. KNOEFEL, M.D., LAWRENCE A. DAVIS, M.D.

Differential Diagnosis of Fibrosing Lung Lesions. WILLIAM MITCHUM, M.D.

Results of Re-treatment in Cancer of the Cervix. WALTER T. MURPHY, M.D.

Roentgen Aspects of Necrotizing Renal Papillitis. RICHARD E. OTTOMAN, M.D., JOHN H. WOODRUFF, JR., M.D., STEFAN WILK, M.D.

Localized Mesothelioma of Pleura: A Review with Six New Cases. HENRY C. BLOUNT, JR., M.D.

SECTION B
MISCELLANEOUS REPORTS
G. S. Hurst, M.S., Presiding

Mathematical Analysis of Radiation Lethality. GEORGE A. SACHER, B.S.

Estimation of Auto-Integral Dose Due to Neutron Capture Gammas. JOSEPH G. HOFFMAN, Ph.D.

Absorbed Dose and Linear Energy Transfer in Radiological Experiments. *M. DANZKER, M.S., AND J. S. LAUGHLIN, Ph.D.

Radiation Dosimetry in Biological Research. *J. E. MORGAN, Ph.D., AND F. P. ELLINGER, M.D.

Ionization of Pure Gases and Mixtures of Gases by 5-Mev Alpha Particles. *T. E. BORTNER, A.B., AND G. S. HURST, M.S.

* Will present paper.

FORTY-FIRST ANNUAL MEETING: COMMERCIAL EXHIBITS

The Commercial Exhibits Committee has felt that a guide to the exhibits to be published prior to the meeting of the Radiological Society might serve a better purpose than a description appearing later. This plan has met with the approval of the exhibitors and, with their cooperation, it is possible to offer the following brief guide to the displays to be seen in December. As always, they will prove an outstanding feature of the meeting.

ABBOTT LABORATORIES, INC., North Chicago, Ill. (Booth 93): The Abbott exhibit will feature the complete line of Abbott radio-pharmaceuticals, including Radiocaps, which provide identical, individually calibrated doses of diagnostic radioiodine in sealed capsule form; Aurcoloid (colloidal radiogold), which continues to be the most widely used means of treating pleural and peritoneal fluid accumulation associated with cancer; Radiocobalt and Actaloy (Co-60 alloy), which provide gamma ray sources equivalent to radium, at far lower cost. The Abbott diagnostic and therapeutic radioiodines are the only ones conforming to USP and NNR standards.

THE ANSCO CORPORATION, Binghamton, N. Y. (Booths 12 and 13).

ATOMIC ENERGY OF CANADA, LTD., Ottawa, Canada (Booths 21 and 22): The chief feature to be shown by Atomic Energy of Canada will be their new Hectocurie Cobalt-60 Beam Therapy Unit, incorporating head capacity to accommodate up to 600 curies, delivering 30 to 40 r per minute at 55 cm.; adjustable diaphragm, providing treatment fields from 2 × 2 to 14 × 14 cm.; built-in treatment couch, adjustable in three dimensions; beam shield for attenuation of primary radiation and up to 45° of scatter; motorized or manual rotation; lightweight construction (under 4,500 pounds).

The AUTOMATIC SERIOGRAPH CORPORATION, College Park, Md. (Booth 104): The Automatic Seriograph Corporation will exhibit the Sanchez-Perez Universal Model 110 Automatic Seriograph. The Seriograph, which utilizes standard 11 × 14-inch cut film, takes twelve individual cassettes, each with its own set of intensifying screens. Since the machine operates on the cassette-changing principle, the same excellent detail can be obtained as with standard single-cassette technic. The unit has an infinitely variable interval speed and will take up to two pictures per second.

BARNES-HIND LABORATORIES, INC., San Francisco, Calif. (Booth 56): Barotrast (specially processed and micronized barium sulfate), the new outstanding development in radiopaque media, will be exhibited by Barnes-Hind Laboratories, Inc. Barotrast is easily prepared, and the resulting palatable, creamy, smooth-flowing mixture does not settle on standing. Because of its unique physical properties, Barotrast resists the effects of mucin, pH changes, and gastric secretions, and therefore coats the entire gastrointestinal tract superbly. Four years of extensive clinical experience have shown consistently superior stomach, small-bowel, and air-contrast studies with this medium. The Pneumocolon for administering Barotrast in air-contrast enemas will also be shown.

BAR-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 99 and 100): The Bar-Ray exhibit features the Hills automatic film processing machine, which automatically delivers 120 completely processed and dried films per hour. The Hills tank is patterned after a unit of similar type recently installed at the New England Baptist Hospital, Boston, Mass. It permits wet emergency viewing at any point from developer through drying. In the event of power failure, it may be converted within a few minutes to manual operation. The tank is smaller by over 30 square feet than other automatic tanks of equal capacity. It does not require a particular location, a costly concrete base, or special plumbing installation.

BELL-CRAIG, INC., New York, N. Y. (Booth 62): The exhibit of Bell-Craig, Inc., manufacturing chemists, consists of a variety of barium sulfate preparations, including the newer, non-flocculating, colloidal type. For hysterosalpingography and cholangiography, an improved Medopaque-H preparation is presented. This product is sterile, aqueous, viscous, and optimally radiopaque. For use in cholecystography, a rapidly-acting oral fat meal of small volume is featured, capable of demonstrating the biliary ducts within ten minutes after administration. Adequate emptying is obtainable within forty minutes after ingestion.

BLAIR X-RAY, INC., Los Angeles, Calif. (Office 403)

BUCK X-OGRAPH COMPANY, St. Louis, Mo. (Booths 31 and 32)

CARR CORPORATION, Culver City, Calif. (Booth 94)

The COCA-COLA COMPANY, Atlanta, Ga. (Booth 6): Ice-cold Coca-Cola will be served through the courtesy and cooperation of the Coca-Cola Bottling Company of Chicago, Inc., and the Coca-Cola Company.

CONTINENTAL X-RAY CORPORATION, Chicago, Ill. (Booths 81 and 82): Many new developments in the x-ray field can be seen at the Continental X-Ray exhibit. Continental X-Ray Corporation manufactures a complete line of diagnostic equipment for the radiologist and hospital. In addition to their regular line, they specialize in custom installations to the user's specifications.

CORECO RESEARCH CORPORATION, New York, N. Y. (Booth 63), will show the Coreco Automatic Color Camera, which is designed to obtain photographs of all surface areas of the body—from 1-to-1 close-up pictures to those of half-body size—and all body cavities, as mouth, throat, ear, nose, vagina, and rectum. The camera carries its own specially developed, fully color-corrected bulb, and a mechanism for complete control of its color temperature and exposure within the camera itself. An automatic view finder is synchronized with the automatic camera mechanism to permit viewing until a fraction of a second before exposure. Provision is made for automatic focusing.

DUNLEE CORPORATION, Chicago, Ill. (Booths 87 and 88)

E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del. (Booths 46–48)

The EASTMAN KODAK COMPANY, Rochester, N. Y. (Booths 79, 80, 89, 90)

EUREKA X-RAY TUBE CORPORATION, Chicago, Ill. (Booth 50), will have on display their new popular 110-kvp, medium-weight, RA-71 over-table Rotating Anode Unit. Also on display will be the RA-51 Rotating Anode Unit and a complete line of pure tungsten and thoriated valve tubes.

The FAIRCHILD CAMERA AND INSTRUMENT CORPORATION, Syosset, N. Y. (Booths 74 and 75), is exhibiting the new Model X-70S Super Speed Fairchild-Odelca Photofluorographic Camera. This camera expands photofluorographic application beyond the routine "mass chest survey." Because unequaled mirror optics are used in the unit, x-ray exposure can be reduced by 75 to 80 per cent from that previously required. In addition, detail sharpness is improved approximately fourfold. New photofluorographic roll film and cut film viewers will also be shown, along with a revolutionary new 70-mm. film dryer.

L. M. FORSYTH MANUFACTURING COMPANY, Chicago, Ill. (Booth 36)

E. FOUGERA & CO., INC., New York, N. Y. (Booth 70), announce the availability of Visciodol, a Lipiodol-Sulfanilamide suspension indicated for bronchography. This new contrast medium offers the outstanding advantages of rapid elimination, no alveolar filling, and the superior opacity and tolerance of classic Lipiodol. Representatives will be on hand to acquaint physicians with the rationale of Visciodol, technics of administration, and other pertinent data. Clinical supplies for trial will be made available on request.

FRANKLIN X-RAY CORPORATION, Philadelphia, Penna. (Booths 71–73): Two special pieces of x-ray apparatus will be shown: the Radiographic Headstand, with its special Head Clamp and Chair, and a New Rapid Film Changer which will move roll film, 11 × 14 inches, at 6 frames per second. The film comes out of the machine as cut film ready for conventional hangers or as roll film, whichever is preferred. Mounted on a completely counterbalanced stand, this changer permits all positions and angles.

GENERAL ELECTRIC COMPANY, Milwaukee, Wisc. (Booths 25–30): General Electric X-Ray Department is exhibiting two diagnostic units and a new illuminator. The Imperial features ring-mounting of both its x-ray table and spot-film unit and permits integration of an overhead tube support without ceiling installation, alteration, or reconstruction. The Regent features an overhead tube support, a lightweight spot-film unit, and a hydraulic drive for smooth varying-speed table angulation. A corrosion-proof fibreglass illuminator providing even, shadowless illumination will be introduced.

GRUNE & STRATTON, New York, N. Y. (Booth 24), extends an invitation to examine recent books with Mr. Frank Kurzer: the monumental Case-Schinz *Roentgen-Diagnostics;* the new English edition of Köhler's completely revised *Skeletal Roentgenology;* Bendick's *Diagnostic Advances in Gastrointestinal Roentgenology;* Storch's second revised edition of *Fundamentals of Clinical Fluoroscopy;* the first American edition of Zdansky's *Roentgen Diagnosis of the Heart and Great Vessels;* the new English edition of Böhler's 3-volume set, *The Treatment of Fractures;* the new seventh edition of Clark's *Positioning in Radiography,* and other valuable works for the radiologist.

HALSEY X-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 83 and 84), manufacturers of a complete line of quality x-ray accessories, will feature their new, thin, lightweight, durable Wafer Cassette. Also to be exhibited are their re-designed illuminator line, ranging from the singles to mobile banks, with conventional, instantgrip and autogrip film-holding devices. Other accessories on display will include film hangers, safelights, protective materials, corner rounders, and identification printers, as well as many other items necessary in the x-ray department.

HARLAN X-RAY COMPANY, Burbank, Calif. (Booth 67)

KELEKET X-RAY CORPORATION, Covington, Ky. (Booths 100–103)

LEA & FEBIGER, Philadelphia, Penna. (Booth 33), urge everyone attending the meeting to see these books of interest: Epstein's *The Spine;* Davidoff and Epstein's *The Abnormal Pneumoencephalogram;* Davidoff and Dyke's *The Normal Encephalogram;* Epstein and Davidoff's *Atlas of Skull Roentgenograms;* Ritvo's *Bone and Joint X-Ray Diagnosis;* Ritvo and Shauffer's *Gastrointestinal X-Ray Diagnosis;* Ritvo's *Chest X-Ray Diagnosis;* Rhinehart's *Roentgenographic Technique;* Delario's *Roentgen, Radium and Radioisotope Therapy;* Holmes and Schultz's *Therapeutic Radiology;* Pohle's *Clinical Radiation Therapy;* Wesson's *Urologic Roentgenology;* Shurtleff's *Radiographic Technic.*

LIEBEL-FLARSHEIM COMPANY, Cincinnati, Ohio (Booth 85)

LOGETRONICS, INC., Washington, D. C. (Booth 42), will display the revolutionary LogEtronic photographic printer and LogEtronic duplicate x-ray negatives. Original x-ray negatives usually contain more detail than is visible to the human eye. The LogEtronic printer automatically transfers such detail to duplicate negatives in visible form. LogEtronic x-ray paper prints showing fine detail are of interest to writers and publishers for better reproduction.

LOW X-RAY FILM CORPORATION, New York, N. Y. (Booths 68 and 69), is the exclusive distributor of Gevaert Blue-Base X-ray Films in the United States. Gevaert (pronounced "gave art") is one of the world's oldest and largest manufacturers of x-ray and photographic products. On display will be Gevaert's "screen" film (Curix), notable for fine contrast, extra speed, and superb definition, and Gevaert's exclusive non-screen film (Osray). Each film is individually packed in a lightproof envelope, ready for instant use without darkroom loading.

MACHLETT LABORATORIES, Springdale, Conn. (Booths 91 and 92)

MALLINCKRODT CHEMICAL WORKS, St. Louis, Mo. (Booth 65): Mallinckrodt extends a cordial invitation to visit their booth. Representatives will be on hand to discuss the various applications of their radiopaque media, including Urokon* Sodium, Barium Sulfate USP, and their new intravenous urographic medium, Miokon** Sodium 50 per cent.

F. MATTERN MANUFACTURING COMPANY, Chicago, Ill. (Booths 51–53)

* Reg. U. S. Pat. Off.
** Trademark.

MEDICAL CASE HISTORY BUREAU, New York, N. Y. (Booth 95): Representatives of the Medical Case History Bureau will be pleased to explain and demonstrate the Info-dex Cancer Registry System, a simplified cancer registry system devised in collaboration with the Statistical Department of the American Cancer Society and meeting the requirements of the American College of Surgeons. This is a simple, compact, inexpensive system designed for use in small as well as large hospitals.

MICRO X-RAY RECORDER, INC., Chicago, Ill. (Booth 20): The Micro X-Ray Recorder is a microfilming unit that will record roentgenograms, photographs, charts, electrocardiograms, case histories, and specimens on a 100-foot roll of 35-mm. film. Of special interest is its two-lens system and provision for lightening-up "over-exposed" films. The Micro X-Ray Recorder viewers, readers, projectors, indexers, 35-mm. mounts, and other accessories will also be shown. New series of 35-mm. Micro X-Ray Recorder slides, 2 × 2 inches, for lectures, teaching and reference will also be featured.

NRD INSTRUMENT COMPANY, St. Louis, Mo. (Booths 59–61)

THE NORTH AMERICAN PHILIPS COMPANY, Mt. Vernon, N. Y. (Booths 37–40)

The NUCLEAR INSTRUMENT AND CHEMICAL CORPORATION (NUCLEAR-CHICAGO) (Booth 14), will exhibit a complete line of radiation-measuring equipment including the "Mediac" (an automatic percentage scaler for thyroid uptake measurements), scintillation detectors, scalers, counting rate meters, personnel protection devices, and other special medical instrumentation for use with radioisotopes. Representatives of the company in attendance at the exhibit will be glad to be of assistance to anyone attending the meeting.

OLD DELFT OPTICAL COMPANY, INC., New York, N. Y. (Booth 54)

PAKO CORPORATION, Minneapolis, Minn. (Booth 34)

PHYSICIANS' TECHNICAL EQUIPMENT COMPANY, Milwaukee, Wisc. (Booth 86)

PICKER X-RAY CORPORATION, White Plains, N. Y. (Booths 15–19)

PROFEXRAY, INC., Maywood, Ill. (Booths 44 and 45): Featured at the booth of Profexray will be their top radiographic-fluoroscopic unit, the TC-5, with a spot-film device that permits the taking of one to five spot radiographs without changing film. The tilt-table is motor driven. The all-automatic push-button control provides electronically monitored triple-interlocking control of time-kv-ma factors at all settings.

RADIATION COUNTER LABORATORIES, INC., Skokie, Ill. (Booth 55), will exhibit a Medical Gamma Ray Spectrometer developed for medical isotope work. In this instrument only gamma radiation characteristic of the isotope for which the machine is set is counted. Also shown will be a Precision Four pi Counter, Recording Spectrogammeometer, which plots spectra of gamma-emitting isotopes, Micropipets, Lyophilizers, and scientific glassware.

RADIOLOGY, Detroit, Mich (Booth 35): Representatives from the editorial offices of Radiology, the official organ of the Radiological Society of North America, will be on hand to answer questions concerning the publication, offer suggestions to would-be contributors, and take subscriptions to the journal and the Cumulative Indexes.

RADIUM CHEMICAL COMPANY, INC., New York, N. Y. (Booth 11): Photographs showing the mining and refining of radium will offer an interesting subject for discussion in Booth 11, where the Radium Chemical Company will feature their latest instruments and accessories for the handling and application of radium and radon. The display will include modern cervical-uterine radium applicators. Many of the new accessory items will be demonstrated.

R-P CORPORATION, St. Louis, Mo. (Booth 64), will show several models of the Drymaster line of x-ray film dryers. Included in the exhibit will be a new all stainless steel 60-film capacity dryer known as the "Drymaster-60."

SCHERING CORPORATION, Bloomfield, N. J. (Booth 77): Members of the Radiological Society of North America and their guests are cordially invited to visit the Schering exhibit, where new therapeutic developments will be featured. Schering representatives will be present to discuss these products.

SCHICK X-RAY COMPANY, INC., Chicago, Ill. (Booth 57), is showing the Pleromobil 300-C. This product of Elema AB, Stockholm, Sweden, is a 300-ma mobile x-ray unit offering new possibilities of radiography and fluoroscopy in operating rooms, at the patient's bedside, etc. Also available are the Elema single and bi-plane film changers and the new Telegamma Cobalt Bomb.

FRANK SCHOLZ X-RAY CORPORATION, Boston, Mass. (Booth 76), will have on display different models of their spot-film devices with automatic cassette return, phototimers with stationary optical pick-up, and supporting structures for their spot-film apparatus.

STANDARD X-RAY COMPANY, Chicago, Ill. (Booths 7–10), will exhibit modern x-ray apparatus, including the Ceiling Mounted Tubestand, Duotilt 90/90 Combination Radiographic and Fluoroscopic Table with Automatic Spot Device, etc. This equipment is designed for use by the radiologist for office or hospital installation. Attendants will be pleased to discuss individual requirements and demonstrate apparatus on exhibit.

TIMES FACSIMILE CORPORATION, New York, N. Y. (Booth 58)

TRACERLAB, INC., Boston, Mass. (Booths 96 and 97): Tracerlab, Boston pioneer in medical applications of radioactive materials, will show a wide variety of instruments of interest to radiologists. Scalers, sample changers, automatic counting equipment, a tracer-scanner which automatically traces the diffusion of radioiodine in the thyroid, and a medical spectrometer will be shown among other things.

UNITED STATES RADIUM CORPORATION, New York, N. Y. (Booth 23): In addition to its complete line of x-ray screens, the Radelin Division of the United States Radium Corporation will exhibit two new items: Radelin Screen Cleaner and the Radelin Tech-Pen. The cleaner, formulated specifically for screens, cleans, preserves, and inhibits static. It comes in a modern pressure packaged container for easy and economical application. The Radelin ballpoint Tech-Pen and its permanent yellow ink were designed especially for marking x-ray films, screens, cassettes, and other hard surfaces.

VICTOREEN INSTRUMENT COMPANY, Cleveland, Ohio (Booth 49), will exhibit a variety of high-, medium-, and low-energy ionization chambers, including beryllium end-window types. New, low-energy chambers with high accuracy are included. There will also be a complete display of dosimeters and rate-meters for personal and laboratory use, including low-energy beryllium window survey meters.

WEBSTER PHOTOCRAFT, Ft. Lauderdale, Fla. (Booth 66): On display will be the Master X-Ray Vu-Graph for projecting a 10-inch square of 14 × 17-inch films, miniature films 2 3/4 × 4 inches, 35-mm. film, or lantern slides. There will also be shown an *Atlas of Miniature Roentgenographs* for use in conjunction with Sante's *Principles of Roentgenological Interpretation*. Bone Diseases: 30 sets of 50 films each. The Respiratory System: 14 sets of 50 films each.

WESTINGHOUSE X-RAY DIVISION, Baltimore, Md. (Booths 1–5), will show the following equipment of advanced design: (1) Cine-Fluorex, fluoroscopic image amplifier with cine attachment; (2) Aeroflex, new ceiling tubestand with tremendous coverage; (3) Diaflex, new diagnostic table with "hide-a-way" spot-film device; (4) Pan-A-Vue, a panoramic viewer in single or double section; (5) Bariumette, self-contained barium kitchen; (6) Fluoradex, deluxe diagnostic table with revised features on spot-film device; (7) Veriflex,

simplified control, 300 or 500 ma.; (8) Pendulum Therapy Unit with treatment table on rails.

The WILLIAMS & WILKINS COMPANY, Baltimore, Md., (Booth 43), publishers of the two-volume loose-leaf *Diagnostic Roentgenology*, edited by Ross Golden, M.D., announce the latest renewal pages. Carefully written, fully detailed, and profusely illustrated, this new section is a replacement of the present Chapter 4. Its title is *Clinical Roentgenology of the Cardiovascular System*, and it is written by Robert N. Cooley and Robert Sloan. Order it, to keep your set up to date.

WINTHROP-STEARNS, INC., New York, N. Y. (Booth 41) is featuring the following radiodiagnostic media: Telepaque, a highly effective and well tolerated oral cholecystopaque medium, giving denser, clear-cut pictures of the gallbladder and, in a substantial number of cases, permitting visualization of the biliary ducts; Hypaque sodium 50 per cent sterile solution (ampuls of 30 c.c.), a new, well tolerated, highly radiopaque medium for excretion urography, containing 59.87 per cent iodine. Hypaque produces excretory urograms of a clarity approaching that usually obtained by the retrograde method.

WOLF X-RAY PRODUCTS, Brooklyn, N. Y. (Office 402): Held in a private parlor on the convention floor, the Wolf exhibit will feature an extensive line of x-ray gloves and aprons along with illuminators and other quality x-ray accessories. An open invitation is extended to visit the Wolf display and "browse around."

The YEAR BOOK PUBLISHERS, Chicago, Ill. (Booth 98), will again have available for inspection many distinguished books. Among them will be the new *Diagnosis of Congenital Heart Disease*, by Kjellberg and Associates; *Pelvo-Spondylitis Ossificans*, a clinical and technical study, by Romanus and Ydén; Rigler's *Roentgen Diagnosis of the Chest;* the American College of Radiology's *Planning Guide for Radiologic Installations; The Lung: Clinical Physiology and Pulmonary Function Tests*, by Comroe and Associates; Birnbaum's *Anatomy of the Bronchovascular System; Radiology for Medical Students* (2nd Edition), by Hodges, Lampe, and Holt.

ANNOUNCEMENTS AND BOOK REVIEWS

EIGHTH INTERNATIONAL CONGRESS OF RADIOLOGY

In accordance with the decision of the International Committee which met in Copenhagen in July 1953, the Eighth International Congress of Radiology will take place in Mexico City in 1956, July 22–28. The officers are as follows: President, Prof. Dr. Manuel F. Madrazo, F.A.C.R.; Secretary-General, Dr. José Noriega L., D.M.R. (London); Treasurer, Mr. Bernabé A. del Valle; Vice-Presidents, Prof. Dr. Narno Dorbecker C. (Diagnosis), Dr. Jesús M. Farías (Therapy), Prof. Dr. Guillermo Montaño (Physics), Dr. Manual Riebeling, F.A.C.R. (Radiobiology), Dr. Francisco Bassols (Technology).

Radiologists throughout the world will be welcome at the Congress. All national radiological societies are requested to supply lists of their members, so that full details as to registration for the Congress, as soon as they are available, may be sent to all radiologists individually.

Correspondence should be addressed to the Congress Office, Calle del Oro 15, México 7, D. F., México.

CLEVELAND RADIOLOGICAL SOCIETY

The newly elected officers of the Cleveland Radiological Society are: President, H. F. Inderlied, M.D.,; Vice-President, Emmett J. O'Malley, M.D.; Secretary-Treasurer, Arthur S. Tucker, M.D., Cleveland Clinic; Member at Large, Eric Baeyer, M.D.

CENTRAL OHIO RADIOLOGICAL SOCIETY

At a recent meeting of the Central Ohio Radiological Society, the following were elected to office: Frederick Bavendam, M.D., Springfield, President; Hugh A. Cregg, M.D., Marion, Vice President; Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus, Secretary-Treasurer. The Society meets at 6:30 P.M., on the second Thursday of October, November, January, March, and May, at the Fort Hayes Hotel, Columbus.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society, the following officers were elected for the year 1955–1956: President, Max Ritvo, M.D., Boston; Vice-President, A. Bradley Soule, Jr., M.D., Burlington, Vt.; Treasurer, Magnus I. Smedal, M.D., Boston; Secretary, Raymond A. Dillon, M.D., 24 Wedgemere Avenue, Winchester, Mass. The Society meets monthly, October through May, at the Hotel Commander, Cambridge, Mass.

OAK RIDGE INSTITUTE OF NUCLEAR STUDIES: SPECIAL COURSES

The Oak Ridge Institute of Nuclear Studies announces the 47th–53rd basic courses in isotope technics to be held on the following dates:

47th	Oct. 17–Nov. 11, 1955
48th	Jan. 9–Feb. 3, 1956
49th	Feb. 6–March 2, 1956
50th	April 16–May 11, 1956
51st	June 4–June 29, 1956
52nd	July 16–Aug. 10, 1956
53rd	Aug. 13–Sept. 7, 1956

These basic courses are designed to assist mature scientific and technical personnel in obtaining in a short time sufficient facility in the use of radioisotopes to utilize them safely and efficiently in their own research work. The minimum scholastic requirement for enrollment is a bachelor's degree, preferably in a scientific field, although no specific courses are required as prerequisites. Enrollment for any one course is limited to thirty-two. Tuition is $25.00.

Application blanks and further information may be obtained by writing Dr. Ralph T. Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn. Applications and supporting letters should be in the hands of the Institute three months in advance of the starting date of the course for which application is made.

There are also being offered advanced courses in veterinary radiological health, specifically to meet the needs of Armed-Forces veterinarians. Starting dates for these courses are Sept. 12, Sept. 26, Oct. 10, Oct. 24, Nov. 7, 1955, March 12, April 9, April 23, and May 7, 1956.

A REQUEST FROM THE NECROLOGY COMMITTEE

RADIOLOGY is glad to cooperate with the Necrology Committee of our Society in an effort to obtain more prompt notification of the death of members. The Chairman of the Committee writes:

"Information as to the death of a member of the Radiological Society of North America comes as a rule from the J.A.M.A. listing, which is usually more than three months delayed. You can do your deceased friend a courtesy and the membership of the RSNA a kindness by mailing to the Secretary, Dr. Donald S. Childs, the name or names of any members whom you know have died since July 1 of this present year. If you know the exact date of death, please list this as well."

While this note has immediate reference to the present year, it is equally applicable to the future.

If duplicate notifications could be made to the Editor of RADIOLOGY, earlier publication of death notices would be assured.

NINETEENTH CONGRESS, SOCIETÁ ITALIANA DI RADIOLOGIA MEDICA

The Nineteenth Congress of the Italian Society of Radiologic Medicine will be held in Genoa, April 8–10, 1956. The themes of the Congress include Radiologic Studies of the Cardiovascular System; Modern Methods of Contrast Radiology; Radiotherapy of the Diencephalo-Hypophyseal Region. The Inaugural Dissertation will be presented by Prof. Arcangelo Vespignani, whose subject will be Functional Factors in the Radiologic Syndrome of the Digestive System.

Professor Alessandro Vallebona is President of the Congress and Dr. Alessandro Piazza, Istituto di Radiologia Medica dell'Universitá, Spedali S. Martino, Genova, Secretary-General. Requests for Information should be sent to the latter address.

THE RESIDENT PHYSICIAN

Announcement has been made of the publication of a new medical journal, *The Resident Physician*, devoted especially to the problems—current and future—of the resident. The editor is Dr. Perrin H. Long, Chairman, Department of Medicine, College of Medicine, at N.Y.C., State University of New York. This journal will be sent without charge to all resident physicians in radiology.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ROENTGEN INTERPRETATION. By GEORGE W. HOLMES, M.D., Honorary Physician, Massachusetts General Hospital; Clinical Professor of Roentgenology, Emeritus, Harvard Medical School; Radiologist to the Waldo County Hospital, Belfast, Me.; and LAURENCE L. ROBBINS, M.D., Radiologist-in-Chief to the Massachusetts General Hospital; Associate Clinical Professor of Radiology, Harvard Medical School. Eighth Edition, thoroughly revised. A volume of 526 pages, with 371 illustrations. Published by Lea & Febiger, Philadelphia, 1955. Price $10.00.

DIAGNOSIS OF CONGENITAL HEART DISEASE. A Clinical and Technical Study by the Cardiologic Team of the Pediatric Clinic, Karolinska Sjukhuset, Stockholm: SVEN R. KJELLBERG, EDGAR MANNHEIMER, ULF RUDHE, AND BENGT JONSSON. A volume of 650 pages, with 581 illustrations. Published by The Year Book Publishers, Inc., Chicago, 1955. Price $22.00.

NUCLEAR AND RADIOCHEMISTRY. Revised version of Introduction to Radiochemistry. By GERHART FRIEDLANDER, Senior Chemist, Bookhaven National Laboratory, and JOSEPH W. KENNEDY, Professor of Chemistry, Washington University, St. Louis. A volume of 468 pages, with numerous figures and tables. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London, 1955. Price $7.50.

EIGHTEENTH SEMIANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, July 1955. 160 pages. Published by the United States Government Printing Office, Washington, D. C.

RONTGEN-SCHICHTVERFAHREN. GRUNDLAGEN DER TECHNISCHEN ENTWICKLUNG UND DER KLINISCHEN ANWENDUNG FÜR DIE PRAXIS. By Prof. Dr. R. GRIESBACH, Augsburg, and Dr. F. KEMPER, Frankfurt a. M. A volume of 144 pages, with 92 illustrations. Published by Georg Thieme Verlag, Stuttgart. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York, N. Y., 1955. Price DM 39.—($9.30).

Book Reviews

BONE AND JOINT X-RAY DIAGNOSIS. By MAX RITVO, M.D., Assistant Clinical Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts College Medical School; Lecturer on Radiology, Boston University School of Medicine; Director, Department of Radiology and Roentgenologist-in-Chief, Boston City Hospital; Associate Radiologist, Beth Israel Hospital. A volume of 752 pages, with 398 figures. Published by Lea & Febiger, Philadelphia, 1955. Price $20.00.

Among the numerous specialties which are indebted to radiology for a sound basis and a broadening scope, orthopedics takes an important place Dr. Max Ritvo, while he addresses himself primarily to the radiologist, has furnished the orthopedist also with a useful text, the authority of which is assured by the author's many years of experience.

In the course of some 730 pages Dr. Ritvo has covered comprehensively the roentgen manifestations of the anomalies and diseases of the bones, joints, and soft tissues. The text is divided into ten chapters: (1) General Considerations; (2) Hereditary, Congenital and Developmental Disturbances; (3) Traumatic Lesions; (4) Infections; (5) Glandular, Nutritional, and Metabolic Disturbances; (6) Bone Changes due to Chemical Substances and Physical Agents; (7) Diseases of the Joints and

WM. EDGAR REILEY, M.D.

Periarticular Tissues; (8) Bone Tumors; (9) Diseases of the Spinal Canal; (10) Soft-Tissue Roentgenography.

In his consideration of diseases of the skeletal system, the author describes briefly the etiology and pathology, after which he turns to his main concern, the roentgen manifestations and the differential diagnosis. A short bibliography of pertinent literature is appended to many of the chapters. The text is illustrated with well chosen radiographs, which are reproduced in the negative form.

The volume is well printed, though the single column form is less easily read than a two-column page. A good index is included.

This work will be of value and interest to radiologists and students of the skeletal system who desire a brief, clearly written, authoritative source of information.

In Memoriam

WM. EDGAR REILEY, M.D.

1882–1955

Wm. Edgar Reiley, M.D., aged seventy-three years, died at his home in Clearfield, Penna., on June 5, 1955. He had been in failing health for the past few years and was obliged to resign his position as Chief of the Department of Radiology at the Clearfield Hospital in December 1953.

Dr. Reiley was born in Hanover, Penna., the son of Rev. McKendree Reiley, a former pastor of the Fifth Avenue Methodist Church in Altoona, and of Fannie (Baker) Reiley. He was graduated from the Altoona High School in 1902 and from the Southern Homeopathic College of Baltimore, Md., in 1907. After a year of graduate work in New York, he started practice in Clearfield, Penna., where he was associated with the late Samuel J. Waterworth, M.D. Later he took graduate work in radiology at Johns Hopkins University.

Dr. Reiley was one of the chief founders of the Pennsylvania Radiological Society and to him goes much of the credit for the successful growth of that organization in the early days and its continued expansion since. He was twice its president and was its secretary-treasurer for a number of years. He was a member, also, of the American Medical Association, Medical Society of the State of Pennsylvania, Clearfield County Medical Society, American Roentgen Ray Society, and Radiological Society of North America, a Fellow of the American College of Radiology, and a Diplomate of the American Board of Radiology. He was a sincere and enthusiastic radiologist and was well informed in all branches of the specialty.

Surviving Dr. Reiley are his wife, the former Alma Litz of Clearfield, Penna.; two daughters, Mrs. Harry Lawler of Billings, Mont., and Mrs. Meade Stapler of Riverdale, N. J.; and a son, James L. Reiley of Elliotsburg, Penna.

G. D. BLISS, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Riordan, M.D., 550 W. Thomas Rd., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Joe A. Norton, M.D., 843 Donaghey Bldg., Little Rock. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Richard A. Kredel, M.D., 65 N. Madison Ave., Pasadena 1. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, James B. Irwin, M.D., 1831 Fourth Ave., San Diego.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, Tom M. Fullenlove, M.D., 110 El Verano Way, San Francisco 27. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Thomas N. Foster, M.D., 630 E. Santa Clara St., San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, James T. English, M.D., 2000 Van Ness Ave., San Francisco 9. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Stuart A. Patterson, M.D., Larimer County Hospital, Fort Collins. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, John Burbank, M.D., Meriden Hospital, Meriden. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, John A. Long, M.D., 1801 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Gahagen, M.D., 320 Sweet Bldg., Fort Lauderdale. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, André S. Capi, M.D., 300 N. 20th Ave., Hollywood, Fla. Meets monthly, third Wednesday, 8:00 P.M.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ivan Isaacs, M.D., 1645 San Marco Blvd., Jacksonville 7. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles M. Silverstein, M.D., 3254 Peachtree Road, N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, George W. Henry, M.D., 1133 Punchbowl, Honolulu. Meets third Monday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, R. Burns Lewis, M.D., 670 N. Michigan Ave., Chicago 11. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Eugene L. Hendershot, M.D., 118 S.E. First St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, G. S. Ripley, Jr., M.D., West Iron Ave., Salina. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Jewish Hospital, 217 E. Chestnut St., Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, W. S. Neal, M.D., 602 Pere Marquette Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter A. Russell, M.D., August General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

UPPER PENNINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. J. Baggenstoss, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets in Spring and Fall and at annual meeting of State Medical Association.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Packer, M.D., 621 High St., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, D. R. Germann, M.D., University of Kansas Medical Center, Kansas City, Kans. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Edwin C. Ernst, Jr., M.D., 3720 Washington Ave., St. Louis 8. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thomas J. Crowe, M.D., 53 Center St., Northampton, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Raymond A. Dillon, M.D., 24 Wedgemere Ave., Winchester, Mass. Meets monthly on third Friday, October through May, at the Hotel Commander, Cambridge, Mass.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, George G. Green, M.D., 601 Grand Ave., Asbury Park. Meets at Atlantic City with State Medical Society and midwinter in Elizabeth.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Theodore Kamholtz, M.D., 152 Clinton St. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clayton G. Weig, M.D., 135 Linwood Ave., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frances M. Behrendt, 19 Clinton Road, Garden City, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Maxwell H. Poppel, M.D., 550 First Ave., New York 16.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, Charles E. Sherwood, M.D., 260 Crittenden Blvd., Rochester. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maynard G. Priestman, M.D., New Rochelle Hospital, New Rochelle, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur S. Tucker, M.D., Cleveland Clinic. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Richard J. Neubauer, M.D., 831 Carew Tower, Cincinnati 2. Meets first Monday, September to June, Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Significance of Negative Neurosurgical Diagnostic Studies. F. A. Martin, J. E. Webster, and E. S. Gurdjian. Neurology **4**: 902–911, December 1954.

In order to determine the accuracy of neurosurgical diagnostic procedures, 200 cases of verified intracranial mass lesions were reviewed. Two hundred and thirty-six examinations, including pneumoencephalography, ventriculography, and angiography, were performed on 200 patients. Of these, 42 (18 per cent) were considered normal. Thirteen of 82 pneumoencephalograms, 5 of 96 ventriculograms, and 24 of 58 angiograms were reported "negative." It was possible in all instances to determine the site of the lesion during life.

The cases with negative studies could be divided into three groups: Group I consisted of patients who had negative pneumoencephalograms and/or angiograms in whom the diagnosis was made on the basis of clinical findings or survey roentgen examinations. Group II was made up of patients with negative angiograms who were then studied by means of pneumograms, which were diagnostic. Group III comprised patients who were studied by several methods, all of which showed negative findings early in the course of the disease but were positive upon repetition at a later time. Five illustrative cases from each group are presented in detail.

Alterations in the ventricles, the subarachnoid spaces, and the vessels brought about by the presence of a space-occupying mass are produced by application of direct pressure against the vessels or the cavity and by filling of abnormal channels, or both. Direct pressure against a vessel or cavity produces displacement, deformation, obliteration, or dilatation. Thus, a temporal lobe glioma may displace the middle cerebral artery upward or shift the ventricular system toward the opposite side. An olfactory groove meningioma may obliterate the anterior cerebral artery and deform the anterior horn of the lateral ventricle. Commonly seen in the hemispheric lesions is dilatation of the contralateral ventricle due to obstruction of the foramen of Monro.

Occasionally a cystic tumor which communicates with the ventricles may fill with air. Since the widespread use of serial angiography, filling of the intrinsic vessels of a tumor is now more commonly observed.

The question arises as to the size a tumor must attain before these mechanisms alter relationships in the roentgenograms. The volume of the mass apparently is not the crucial factor. More important is the site at which the mass occurs and the response of the normal tissue to its presence. A small mass adjacent to ventricles or vessels will probably alter them early in its growth. When a tumor causes swelling of the cerebral tissue, structures remote from the actual mass itself may become altered. It is for this reason that diagnostic studies may be unreliable in determining the size of the lesion.

When a mass arises at a distance from the ventricles and larger vessels and produces minimal tissue reaction, it may attain a large size before becoming roentgenographically detectable even though the patient may present severe disability. In 2 of the authors' cases, an early glioma of the paracentral gyrus and a parasagittal meningioma, only minimal deformation of the posterior superior aspects of the homolateral ventricle was produced. Such a minimal defect may be mistaken for the normal irregularity of the ventricle caused by the cingulate and paracentral gyri.

Other factors which may contribute to the occurrence of erroneous diagnoses, in addition to those mentioned above, are: (1) insufficient filling of the structures with contrast medium, (2) malpositioning of the patient during roentgenography, and (3) limited experience of the observer. Insufficient filling of the structures may be corrected by repetition of the study. A common source of error is poor filling of the basal cisterns in a pneumoencephalogram and the peripheral branches of the middle cerebral complex in an angiogram. It is important to obtain an accurate anteroposterior or postero-anterior roentgenogram at all times, if slight shifts of the ventricles or anterior cerebral vessels are to be appreciated. Filling of the fourth ventricle may sometimes be secured by positioning the patient so that the air may enter this area.

Of all factors, the most difficult to control is the human element. There is a tendency to interpret minimal defects as normal variations. A difference in the size of the lateral ventricles, slight invagination of the ventricles, and minimal shifts of the vessels may be difficult to appreciate.

Forty-five roentgenograms; 5 photographs.

The Pneumographic Aspect of the Angioreticuloma (Hemangioblastoma) of the Cerebellum. Giovanni Ruggiero and Francesco Castellano. Acta radiol. **42**: 451–460, December 1954.

A tumor in the posterior fossa in a patient over thirty years of age and with no suggestion of metastases is probably either an acoustic neurinoma, a meningioma, or an angioreticuloma. The authors present, in summary, 15 cases of cerebellar angioreticuloma. Routine examination of the skull, performed in 12 cases, showed signs of increased intracranial pressure in 4 (33 per cent). A forward and contralateral displacement of the aqueduct and fourth ventricle proved to be a characteristic ventriculographic feature. The aqueduct is usually kinked and the fourth ventricle dilated. Deformity of the fourth ventricle was present in one-third of the cases. This latter finding was never observed in cases of meningioma and it is therefore felt to be almost pathognomonic of angioreticuloma. Upward displacement of the posterior part of the third ventricle is more marked in angioreticuloma than in meningioma. Another differential feature is the direct involvement of bone present in some cases of meningioma. The roentgen signs of acoustic neurinoma are characteristic and well known.

Encephalography by suboccipital injection was attempted in 3 cases, but is not advocated by the authors. In a case not included in the series reported, lumbar encephalography was performed according to Lindgren's technic (Acta radiol. **31**: 161, 1949. Abst. in Radiology **54**: 130, 1950), and a diagnosis of tumor of the posterior fossa was made on the basis of changes in the basal cisterns. This procedure is generally regarded as dangerous in posterior fossa tumors, but 3 cases of cerebellar angioreticuloma are cited in which it

was inadvertently performed without accident (Gardner and Nosik: Am. J. Roentgenol. **47:** 691, 1942. Abst. in Radiology **40:** 615, 1943). It may be useful in demonstrating cerebellar herniation.

Five roentgenograms. DAVID E. WHEELER, M.D.
Indiana University

Neuromyelitis Optica Simulating Spinal Cord Tumor. Report of a Case, with a Review of Nine Additional Cases. James W. Markham and Frank J. Otenasek. Arch. Neurol. & Psychiat. **72:** 758–763, December 1954.

A 29-year-old farmer complained of aching pains in both thighs, weakness of the right arm and leg, and loss of temperature sensation on the left side of the body for the past three days. Neurologic examination revealed minimal pyramidal tract signs on the right and a sensory level at C-6 on the left. A myelogram demonstrated a complete block at the level of C-6. At laminectomy the spinal cord was found to be swollen, but no tumor was seen.

During the next month, a progressive paraplegia developed, with numbness below the umbilicus and loss of bladder and bowel control. Approximately three months after operation there was a marked blurring of vision of both eyes. Examination at this time revealed bilateral papilledema. One year later, the optic disks were very pale but the patient could read large newspaper type. When he was last seen, almost three years after the onset of his illness, vision was 20/100 in both eyes. He was spastic but was able to walk. The rapid onset of the spinal cord signs in this case was suggestive of an inflammatory or infectious process, but there were no reliable clues to the etiology until the onset of the optic neuritis three months after the initial symptoms. The subarachnoid block on myelography would appear to have been on the basis of the intense myelitic process.

In reviewing the files at the Johns Hopkins Hospital between 1925 and 1952, a total of 10 cases of neuromyelitis optica were found. Both myelitis and optic neuritis must be present at some time during the course of the disease to justify this diagnosis. The average age at onset of symptoms was 27.5 years. Of the 10 patients, 8 were females. The myelitis appeared before the optic neuritis in 5 cases, while the reverse was true in 4 cases. In the other case the onset was simultaneous. The average interval between the appearance of myelitis and optic neuritis was three months.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Cephalographic Diagnosis in the Surgical Treatment of Malformations of the Face. Harry H. Shapiro and John Marquis Converse. Am. J. Surg. **88:** 864–872, December 1954.

The authors describe a method of preoperative cephalographic diagnosis to serve as an aid in reconstructive facial surgery. The intersections of various planes and lines, which are drawn upon tracings of cephalograms, form angles which may be measured and compared with accepted standards.

The landmarks used in this study were: (1) the center of the sella turcica, (2) nasion (the most anterior point in the mid-sagittal plane of the skull, at the junction of the frontal and nasal bones), and (3) mentum (the most anterosuperior point on the outer surface of the bony chin, also known as the pogonion). On the sagittal plane cephalogram the line between the sella turcica and nasion is taken as the cranial base line; a line between the mentum and nasion is the facial plane. The angle formed by the intersection of these two lines averages approximately 75 degrees in the well balanced face.

Studies of five types of facial malformation are presented. The first is underdevelopment of the mandibular symphysis. In the case illustrated the angle at the intersection of the cranial base line and the facial plane measured 69 degrees. A new facial plane was drawn on the cephalograms by increasing the angle to 75 degrees, and the distance between the mentum and the new diagnostic plane was measured. A bone graft of corresponding size could then be used.

The second type is an elongated and retruded mandible. The same general measurements are made to determine the size of the bone graft needed. In this instance the bone needed for the graft can be removed from the lower portion of the body of the jaw and then shifted anteriorly.

The third malformation considered is mandibular prognathism. In a case of this type the sagittal plane cephalograms of the osseous and soft-tissue structure were found to be of value in planning surgical correction.

In the fourth case there was asymmetry of the lower portion of the face, and postero-anterior cephalograms were needed. The line of reference in this instance is drawn along the margins of the mandibular rami and an attempt is made to form similar angles on each side.

The fifth type of case involves loss of a portion of the mandible accompanied by a lessened vertical dimension of the face. In such a case lateral cephalograms will demonstrate the desired location of the mentum, as well as the dimension necessary to reconstruct the inferior portion of the face.

Fifteen cephalograms; 15 tracings.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

THE CHEST

Intralobar Pulmonary Sequestration. Report of Three Cases, with Two Additional Cases of Agenesis of the Right Upper and Middle Lobes in Combination with Anomalous Systemic Vessels. Anthony Lalli, Ralph F. Carlson, and W. E. Adams. Arch. Surg. **69:** 797–805, December 1954.

In intralobar pulmonary sequestration, an anomalous artery runs from the descending aorta to an area of congenitally cystic lung, which usually does not communicate with a bronchus. The sequestrated lobe is therefore not visualized by bronchography. Intralobar sequestration should be differentiated from extralobar sequestration, or lower accessory lung, with a hilus attached to the parietes, esophagus, or diaphragm and a venous system draining into the azygos or gastrointestinal veins.

Three cases of intralobar sequestration are presented and findings in 2 patients with anomalous vessels arising from the aorta in combination with agenesis of a lobe are also described.

Chronic recurrent infection of the anomalous lung usually calls attention to the disease. Roentgenograms frequently reveal localized cystic areas, often with fluid levels. Surgical extirpation of the seques-

trated segment is the treatment of choice. The 2 cases of agenesis with anomalous arteries were explored but not treated.

The authors make no mention of the use of arteriography in demonstrating the anomalous vessels but stress consideration of the presence of such a vessel to prevent fatal hemorrhage.

Ten roentgenograms; 2 photographs.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Histoplasmosis of Lungs. Benjamin Schwartz. Arch. Int. Med. **94:** 970–994, December 1954.

Histoplasmosis is an infectious disease of protean clinical manifestations, since the causative organism, the fungus *Histoplasma capsulatum*, may affect practically any tissue of the body. The organs most commonly involved are the lymph nodes, liver, lungs, spleen, adrenal glands, bone marrow, kidneys, intestinal tract, oropharynx, larynx, and skin. Up to the present time only about 200 cases of all varieties of histoplasmosis confirmed by cultural or histological methods have been reported in the world literature. In more than half of these patients there was definite evidence of pulmonary involvement, either as the sole manifestation of the disease or in association with other organ involvement.

Histoplasmosis is most prevalent in the Mississippi, Ohio, and Missouri River valleys, which constitute the major endemic zone for this disease. Lesser geographic foci have been discovered in recent years in the United States, far removed from the major endemic regions.

Histoplasmosis may simulate almost any form of acute or chronic disease of the lungs. A classification is presented which is based on the pathogenesis of the pulmonary lesions, their roentgenographic appearance, and a determination of activity on the basis not only of serial roentgen studies as to stability of the lesions, but also of the clinical manifestations and specific laboratory findings.

1. Benign primary infection form, resembling a primary tuberculous infection
   (*a*) Active
   (*b*) Inactive
2. Chronic reinfection form, resembling reinfection tuberculosis
   (*a*) Active
   (*b*) Inactive
3. Mediastinal form, resembling mediastinal lymphomata
   (*a*) Active
   (*b*) Inactive
4. Diffuse interstitial pneumonic form, resembling viral pneumonia or miliary tuberculosis
   (*a*) Active (sporadic or epidemic)
   (*b*) Inactive, residuals of sporadic or epidemic infection

A positive complement-fixation test for histoplasmosis in the higher titers may be of considerable confirmatory value during the acute stage. However, one negative test during the acute phase does not exclude the diagnosis. Serial tests should be performed during the acute illness and during convalescence in order to detect conversion of a negative to a positive serologic reaction. During the chronic phase of the disease, this serologic test cannot be relied upon for diagnosis, since it is usually either negative or positive only in low dilutions. The histoplasmin skin test has its greatest usefulness during the chronic inactive stage of the disease, since in the majority of patients skin sensitivity will persist indefinitely after the infection has been contracted.

Eight roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California, S.F.

Cystic Changes of the Lungs in Histiocytosis. Theodore E. Keats and Jackson F. Crane. Am. J. Dis. Child. **88:** 764–771, December 1954.

A case of the Letterer-Siwe form of histiocytosis with primary pulmonary involvement in a white female child of two and a half years is reported. The presenting symptom was respiratory embarrassment. The illness had been marked by weight loss, anorexia, and pallor of approximately two to three months duration. The roentgenograms showed small, cystic appearing, radiolucent areas scattered diffusely throughout both lung fields and interspersed with linear and nodular infiltration.

The child died eleven days after admission, and at autopsy the lungs showed a diffuse and nodular infiltrate of large atypical non-lipid histiocytic and reticuloendothelial cells associated with eosinophilic leukocytes, giant cells, and focal necrosis. There was massive involvement of the lungs and thymus but only minimal involvement of thyroid, liver, and bone marrow, with no specific involvement of lymph nodes and spleen. It appeared that the nodules of infiltration had undergone central necrosis, with subsequent aeration of these central areas and the resultant formation of cysts. There was no apparent connection between these cystic areas, for the most part, and terminal bronchi or bronchioles.

It is pointed out that pulmonary involvement without cyst formation in the histiocytoses is not uncommon, particularly in Letterer-Siwe disease, but that a "honeycomb" lung is unusual. Such a case makes it necessary to consider histiocytosis as a possibility in any instance of cystic disease of the lungs.

Two roentgenograms; 2 photographs; 4 photomicrographs.

H. G. PETERSON, JR., M.D.
New Britain, Conn.

Grain Dust Pneumoconiosis. J. R. Rüttner and A. Stofer. Schweiz. med. Wchnschr. **84:** 1433–1436, Dec. 25, 1954. (In German)

Pneumoconiosis caused by grain dust represents a great rarity. In the recent literature, especially in England and America, there have appeared some publications about "farmers' lungs" and "threshers' lungs." [See, for example, papers by Studdert and by Soucheray. Abst in Radiology **62:** 610, 1954, and **64:** 288, 1955, though these are not among those mentioned by the authors.] These papers, however, do not deal with direct damage due to grain dust; rather, they discuss mycotic infections of the bronchi and the lungs, or bronchomycoses.

In 1932, Boerger described a chronic foreign-body pneumonia caused by grain dust (Beitr. z. path. Anat. u. z. allg. Path. **89:** 135, 1932), and in 1953, Doerr described in detail a pneumonoconiosis of similar origin (Virchows Arch. f. path. Anat. **324:** 263, 1953).

Recently, the authors observed a grain dust pneumonoconiosis, which exhibited such typical clinical, roentgenologic, pathologic, and anamnestic features that they considered the case worth reporting.

A white male, born in 1903, had for many years been employed as a miller. In 1944, he had to change his occupation because of a fracture of the left foot. Beginning in 1947, he experienced increasing shortness of breath, especially on exertion, with asthmatic attacks during the night. A chest film in 1951 showed nodular enlargement of the hilar shadows bilaterally, with pneumonic infiltration in the left lower field. Bronchoscopy revealed a diffuse granulating process involving the bronchial mucosa, with stenosis of the lumen. The pulmonary changes progressed continuously and a chest film in June 1953 exhibited large nodular shadows in both lower and middle lung fields with infraclavicular emphysema and enlargement of the heart. The clinical picture revealed dyspnea at rest, cyanosis, cardiac decompensation with edema, ascites, and congestion of lungs and liver. Death occurred in September 1953 with final extreme pulmonary edema.

Autopsy first aroused the suspicion of silicosis. Histologic sections, however, revealed a number of peculiar nodules and bodies, somewhat round and globular in shape. Histochemical examination, including tests with Lugol's solution, indicated their organic nature and the presence of vegetable constituents.

The process was characterized by a chronic granulomatous and fibroblastic foreign-body inflammation in the lungs and the regional lymph nodes. The foreign bodies could be identified as grain dust particles and were apparently the result of inhalation during the milling process.

Two roentgenograms; 5 photomicrographs.

HERBERT POLLACK, M.D.
Chicago, Ill.

Talc Pneumoconiosis in the Textile Industry. Bertram Mann and J. B. Deasy. Brit. M. J. **2**: 1460–1461, Dec. 18, 1954.

Although talc pneumoconiosis is mainly found in workers in talc mills or steatite mines and in the rubber and cosmetic industries, the case reported here occurred in a "picker maker" in the textile industry. The talc was inhaled as he dusted hides with talc (French chalk, hydrated magnesium silicate). Dyspnea, cough, and expectoration developed after thirty-nine years at this occupation.

Roentgen examination revealed nodular shadows of homogeneous density superimposed upon a latticework background. A diffuse opacity in the apex suggested a coexistent pulmonary tuberculosis.

One roentgenogram.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Bronchiectasis—Dextrocardia—Sinusitis: A Contribution to the Aetiology of Bronchiectasis. Carl E. Gudbjerg. Acta radiol. **42**: 413–420, December 1954.

In a review of the literature a wide variety of opinions were found on the etiology of bronchiectasis. Among those mentioned are atelectasis, inflammation with resultant atelectasis, traction by surrounding lung, as in fibroid tuberculosis, a congenital defect of the bronchial wall, and allergy. The author questions the occurrence of a congenital form of the disease, since the clinical picture in the so-called congenital cases is exactly similar to that in acquired cases and about 60 per cent of so-called congenital forms are not discovered until after the age of twenty.

The association of bronchiectasis with dextrocardia is also believed to be less common than is usually held. In 25 cases of dextrocardia the author found no instance of bronchiectasis. Nor was any evidence found that sinusitis is of etiologic significance. Of 35 patients with bronchiectasis in whom the sinuses were examined, only 10 proved to have sinusitis, and in these cases it appeared that the sinus infection was a result rather than a cause of the bronchiectasis.

Three tables.

W. DONALD JANNEY, M.D.
Indiana University

Mediastinal Emphysema as a Complication of Therapeutic Pneumoperitoneum. B. Mukherjee and K. R. Adhikary. J. Indian M. A. **24**: 208–211, Dec. 16, 1954.

The authors discuss the various types of mediastinal emphysema and present 2 cases to illustrate its occurrence as a complication of pneumoperitoneum. In both cases the emphysema followed pneumoperitoneum refills and not pneumoperitoneum induction. The authors believe that in these cases the passage of air into the mediastinum can be accounted for by the existence in the anterior abdominal wall of an anatomical pathway formed by the continuity between the transversus abdominis muscle and the diaphragm. In each instance physical examination and lateral roentgenograms revealed evidence of deep surgical emphysema in the anterior abdominal wall. No air could be discerned in the peritoneal cavity in posteroanterior views, suggesting that inadvertently the refills (800 c.c. in 1 case and 600 c.c in the other) had been given mostly extraperitoneally. The initial intraperitoneal pressures during refills were nil, *i.e.*, no initial manometric response was obtained.

Mediastinal emphysema complicating therapeutic pneumoperitoneum in most instances clears up spontaneously with bed rest, and there is usually no contraindication to continuing pneumoperitoneum refills subsequently.

Eight roentgenograms.

Tracheographic and Bronchographic Studies as Aids in the Diagnosis of Congenital Malformations of the Tracheobronchial Tree and Aortic Arch in Infants and Children. Charles F. Ferguson and Carlyle G. Flake. Ann. Otol., Rhin. & Laryng. **63**: 1056–1080, December 1954.

The authors seek to show how the instillation of a contrast medium into the lower respiratory tract, together with endoscopic procedures, may in certain cases be of great assistance in the graphic demonstration of obscure intrathoracic conditions in infants and children. They have brought together here, from the Children's Medical Center of Boston, a series of deficiencies and abnormal connections of the tracheobronchial tree and vascular structures that would be hard to duplicate in a smaller institution.

Immediately following a complete bronchoscopic examination, preferably under general anesthesia,

iodized oil is instilled through a flexible endotracheal catheter tube. Filling of the areas to be outlined is done under fluoroscopic guidance *via* a polyethylene catheter passed through the intubation tube. The amount of the medium varies from 1 to 2 c.c. for a tracheogram in the newborn to 15 to 20 c.c for older children with bronchiectasis. In the younger infants in whom demonstration of the type of tracheal compression is all that is desired, iodized oil may be introduced directly into the subglottic region by means of a small polyethylene catheter without anesthesia.

The authors stress the importance of tracheal stenosis as a cause of stridor and urge examination of the trachea whenever there is any possibility that the larynx may not be responsible. Causes of external compression of the trachea which are considered and illustrated include double aortic arch, right aortic arch, and an anomalous innominate or left common carotid artery, all of which have produced difficulties in swallowing and/or breathing.

Tracheo-esophageal fistulas without atresia may sometimes be demonstrated, and an unusual case of broncho-cholodochal fistula is cited. Bronchial stenosis and agenesis or hypogenesis of the lung are discussed and illustrated.

Twenty-five roentgenograms.

SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

THE CARDIOVASCULAR SYSTEM

Photofluorographic Detection of Cardiovascular Disease in a General Hospital. Harold D. Batt, John M. Allen, Frederick H. Treder, and Robert Shapiro. New England J. Med. **251:** 934–937, Dec. 2, 1954.

More than 6,000 adults admitted to the Hospital of St. Raphael, New Haven, Conn., in 1953 were examined photofluorographically for possible cardiovascular disease. About 700 of these were suspected of having cardiovascular disease on the basis of the admission photofluorogram. In a follow-up study of 595, the diagnosis was confirmed in 497 (83 per cent).

Both postero-anterior and lateral views were taken. No cardiovascular abnormality was discovered solely on the basis of the lateral film, but this view was frequently confirmatory. The highest incidence of lesions was found in the older age group. A higher percentage of medical patients had heart disease than of surgical patients, probably as a result of preliminary screening by the surgeon in selecting patients for admission on the surgical service. Nevertheless, there were 437 patients of the surgical group with verified heart disease, or 13 per cent. The authors consider it likely that not all of these cases were known to the surgeons and point out that, by having attention called to the disease, the patient may benefit.

Two graphs; 2 tables. DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

Atrial Septal Defects in Children. A Clinical Study With Special Emphasis on Indications for Operative Repair. J. Leonard Braudo, Alexander S. Nadas, Abraham M. Rudolph, and Edward B. D. Neuhauser. Pediatrics **14:** 618–631, December 1954.

On the bases of a study of 32 patients, the clinical, electrocardiographic, roentgenologic and physiologic features of atrial septal defect are presented. The principal clinical features are a systolic murmur, usually heard best in the left second intercostal space, a low apical diastolic murmur, and a widely split pulmonic second sound. Incomplete right bundle branch block and evidence of right ventricular hypertrophy are the most common electrocardiographic findings.

Roentgen examination usually reveals some degree of cardiac enlargement, predominantly or selectively right ventricular in origin, increased prominence of the main pulmonary artery, pulmonary vascular engorgement, hilar dance, and auricular enlargement (right or combined right and left but not isolated left). Catheterization studies have shown increased pulmonary blood flow, average or diminished pulmonary vascular resistance, and normal systemic flow index and pressures.

Rheumatic heart disease, patent ductus arteriosus, ventricular septal defect, aortic-pulmonic fenestration and pulmonary hypertension, including Eisenmenger's complex, are to be considered in the differential diagnosis.

In order to appraise the indications for surgical closure of atrial septal defects, the authors reviewed the autopsy files of several large hospitals and a number of reports in the literature, thus collecting an autopsy series of 80 cases. The average age at death was found to be forty years, and less than half the patients died of a cause directly related to the congenital cardiac defect, chiefly congestive failure. An increased incidence of associated rheumatic heart disease (16 patients) was noted. A large left-to-right shunt (twice the systemic cardiac output) with congestive failure or marked limitation of activity is considered definite indication for operation. A large shunt with pronounced cardiomegaly, marked underdevelopment, or pulmonary hypertension, is a probable indication.

The results of surgery in 9 children are reported: 3 died; in 6 the results were considered good.

Nine roentgenograms; 4 photographs; 10 tables.
H. G. PETERSON, JR., M.D.
New Britain, Conn.

Tetralogy of Fallot with Left Ventricular Hypertrophy. Raphael N. Paul, Rene P. Megevand, and Joseph Parker. J. Pediat. **45:** 672–678, December 1954.

The electrocardiogram in the majority of patients with congenital heart diseases leading to cyanosis demonstrates right ventricular hypertrophy. With few exceptions, this is especially true of the tetralogy of Fallot. A case of this latter anomaly is reported, however, with electrocardiographic evidence of *left* ventricular hypertrophy and a roentgenologic picture interpreted as showing dilatation of the left ventricle. A diagnosis of tricuspid atresia was made, but autopsy revealed a typical tetralogy of Fallot with the exception of hypertrophy of the wall of the left ventricle.

Three roentgenograms; 1 photograph; 1 electrocardiogram. HOWARD L. STEINBACH, M.D.
University of California, S. F.

Roentgenologic Diagnosis of Aneurysm of the Thoracic Aorta, with Particular Reference to Study in the Right Posterior Oblique Position. George Levene, Edward N. Burke, and Dolores C. Arnois. Am. J. Roentgenol. **72:** 1004–1015, December 1954.

This paper is concerned with a description of aneurysm and related conditions based primarily on fluoroscopy in the right posterior oblique position. With the patient standing back to the examiner, the left shoulder

is rotated away from the screen. With this maneuver, the shadow of the spine moves to the left and the shadow of the heart to the right. Rotation is continued until the apex of the heart just disappears behind the vertebral column. In this position the entire thoracic aorta is visualized.

The following diagnostic points based on such a view are made:

Arteriosclerosis:

1. Distance between the aortic arch and the sternal notch is reduced.
2. Ascending aorta bulges anteriorly.
3. Descending aorta bulges posteriorly and may buckle into an S curve.
4. Calcification may be seen on the knob and inferiorly.
5. A mass movement of the aorta occurs with shifting of the whole segment rather than expansion.

Aortitis:

1. Ascending aorta appears wide due to relaxation of its walls caused by destruction of muscles as well as elastic fibers; the walls are thickened.
2. Irregularities of the contour may be caused by scarring.
3. Pulsations are diminished.
4. Calcification in the superior wall is invariably due to syphilis.

Hypertension:

1. Aorta appears elongated and tortuous as in arteriosclerosis.
2. There may be increased pulsatile movement of the aorta, causing a "functional widening," reduced after sympathectomy.

Aortic Insufficiency:

1. May occur with syphilitic, rheumatic, or hypertensive heart disease.
2. The vascular pedicle is widened due to engorgement of the superior vena cava, and this is associated with left heart failure.
3. The left ventricle is dilated.
4. The aorta shows a typical large pulsation in which narrowing is quick and sharp due to the low diastolic pressure. This may also be seen with thyrotoxicosis.
5. Ascending aorta may become wide.

Aneurysms (usually syphilitic):

1. May show as a localized bulge.
2. May show as a fusiform enlargement.
3. Heart is not changed unless aortic valve is involved, in which event there is present dilatation of the left ventricle.
4. Pulsations are not reliable, because a clot is often attached to the wall.
5. Aneurysm involving the sinuses of Valsalva frequently project into the right auricle, which may bulge anteriorly.

Dissecting Aneurysm (usually caused by arteriosclerosis):

1. The striking feature is the straightening of the aortic curve of the involved segment.
2. Localized knobby irregularities are caused by blood clots forming in the false lumen.
3. Pulsations are markedly diminished.

Twenty-two roentgenograms; 2 photographs; 11 drawings.

WILLIAM SNOW, M.D.
Shreveport, La.

Traumatic Aortic Aneurysms. Edwin M. Goyette, Hu A. Blake, James H. Forsee, and Henry Swan. Circulation **10:** 824–828, December 1954.

Three cases of aortic aneurysm caused by severe nonpenetrating trauma to the chest are presented. One was not diagnosed until eight years and another two years after the injury. No attempt at repair was made in either of these patients because of the age of the lesion and lack of symptoms (both were found on routine films). The third patient apparently suffered an actual rupture of the aorta at the time of the accident, with leakage of blood into the mediastinum and left hemithorax. Transfusions relieved his symptoms and he was discharged from the hospital without the diagnosis being made. Three months later a routine film showed a large mediastinal mass which was found on angiocardiography to be an aneurysm of the descending aorta. The sac was excised and the aorta closed, but the patient died after three months of hemorrhage from the suture line. It was believed that this was the result of suturing of the sac walls rather than the edges of the torn aorta.

The tearing of the aorta which allows this type of aneurysm to develop is caused by the snapping forward of the relatively free portion of the aorta while the points of attachment (the origin and the area where the main branches are given off) remain fixed. Automobile accidents supplied the necessarily severe trauma in each of the authors' cases.

Five roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Visualization of the Inferior Vena Cava as an Adjunct to Diagnosis of Retroperitoneal Tumors, A Case Report. John M. Keshishian and William A. Spencer. Ann. Surg. **140:** 892–896, December 1954.

The authors report a case of retroperitoneal tumor presenting with sharp pains in the back, hips, and legs. The pain was severe enough to prohibit work. Clinically an abdominal mass was thought to be present. Excretory urograms showed rotation and lateral displacement of the right kidney and ureter. Injection of the vena cava with 70 per cent Urokon *via* a ureteral catheter and planigrams following presacral air insufflation verified the presence of a retroperitoneal mass. The tumor proved to be a small primary adenocarcinoma of the right kidney with multiple secondary components, the latter resulting in the vena caval displacement. Since the vena cava is so easily displaced, the authors believe that it is worthwhile to visualize it when there is doubt as to the location of a mass. If, however, a renal tumor is suspected, aortography is the procedure of choice.

Five roentgenograms; 1 photograph.

G. R. HANSON, M.D.
Cleveland City Hospital

Congenital Absence of a Main Branch of the Pulmonary Artery. J. E. Flynn, A. A. Siebens, and S. F. Williams. Am. J. M. Sc. **228:** 673–679, December 1954.

Absence of the right pulmonary artery was first suspected from a "routine" chest roentgenogram taken on a 25-year-old naval officer with a complaint of hemoptysis. The right lung and hemithorax were considerably smaller than their counterparts on the left. The right hilus was very small. The left lung showed

increased radiolucency and a small herniation of its upper lobe into the mediastinum. Bronchospirometry revealed a marked difference in the contribution of each lung to total function. Although approximately 43 per cent of ventilation at rest was performed on the right, only a negligible quantity of oxygen was taken up by this lung, even when the patient was made to breathe 100 per cent oxygen. It was concluded that virtually none of the patient's pulmonary artery stream was directed to the right lung.

Cardiac catheterization was performed, but attempts to pass the catheter into the right pulmonary artery were unsuccessful. Angiocardiography demonstrated a complete absence of right pulmonary artery flow. The main pulmonary artery continued as a single trunk into the left lung. Simultaneous with opacification of the aorta there appeared faint opacification of a fine network of vessels in the right lung, interpreted as a demonstration of bronchial artery circulation.

Three roentgenograms; 1 graph; 1 table.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Aberrant Right Subclavian Artery. E. A. Petrie. J. Canad. A. Radiologists **5:** 46–51, December 1954.

Symptoms caused by an aberrant right subclavian artery vary from mild dysphagia to marked nutritional deficiency, depending on degree of compression of adjacent structures, particularly the esophagus and trachea. The roentgen appearance is striking and quite typical, and the condition is being more frequently recognized in the living. Diagnosis is important, as severe cases are usually amenable to surgery.

Three types of irregular development of the branches of the arch of the aorta are possible: (1) fewer branches than normal; (2) more numerous branches than normal; (3) abnormal succession of branches. The author presents 5 cases of the last group. In these, the right subclavian artery arose from the arch on the left, distal to the origin of the left subclavian artery. In crossing the mid-line it usually runs between the esophagus and spine, providing the roentgenologist with a characteristic pressure defect on the esophagus posteriorly. The vessel occasionally runs anterior to the esophagus and rarely also anterior to the trachea. The defect on the esophagus is spiral in nature as the vessel ascends as it crosses the mid-line anywhere between the 6th cervical and the 4th thoracic vertebra.

The author reproduces Neuhauser's classification of aortic arch anomalies, since these enter into the differential diagnosis. The posterior type of right aortic arch displaces the esophagus to the left as well as anteriorly, and on careful study of films the arch can be seen at the area of narrowing, while in the presence of a right subclavian artery the arch is seen slightly to the left of the vertebral column rather than at the site of the esophageal defect. The right subclavian artery defect is usually smaller, and the degree of displacement is less than in the posterior right arch defect.

Double aortic arch may result in constriction of both the esophagus and trachea, thus differentiating it from aberrant right subclavian artery. The combination of posterior esophageal compression and anterior tracheal defect in the absence of a demonstrable mediastinal mass is almost certain proof of an encircling vascular ring.

The author concludes that diagnosis of aberrant right subclavian artery by barium swallow is easy and should be sought routinely in patients with symptoms of esophageal pressure. He suggests that possibly in many patients treated for thymic enlargement the symptoms may be due to aberrant subclavian artery.

Four roentgenograms; 2 drawings.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

The Venous Junction of the Glomerular Artery. Armando Trabucco and Fernando Márquez. J. Urol. **72:** 1061–1073, December 1954.

As a continuation of their work on the glomerular apparatus as previously reported (J. Urol. **67:** 235, 1952), the authors now describe the anatomic constitution of that portion of the glomerular artery extending from the glomerulus to the drainage veins.

The technic employed consisted in the injection of the arterial and venous systems of carefully prepared fresh autopsy specimens, at a pressure approximating average normal vascular tension. The injected material was an ammoniated latex preparation, dyed black for the venous system and white for the arterial portion. An interesting observation was made here, in that injection of the arterial system resulted in perfusion of the entire renal vascular tree, whereas injection of the venous side did not cause retrograde flow into the arterial portion. Since no valves could be demonstrated in the veins, the explanation for this phenomenon was the vast discrepancy between the very large venous trunk and the tiny branches of both arteries and veins which opened into this trunk. Following the complete injection, the renal parenchyma was digested in hydrochloric acid, leaving only the set latex cast of the whole vascular apparatus.

Meticulous study revealed two well defined forms of the anatomical structure of the glomerular artery between the glomerulus and the vein. The first group was formed by vessels that underwent the usual division into small capillaries before joining the venous trunk. The second group was composed of vessels ending directly in a vein, without obvious interposition of a prevenous capillary system. It was felt that each of these major groups had a very definite and separate physiological significance.

The first group showed four main variations, depending on the distance from the glomerulus where the capillaries were to be found, and whether or not venous capillaries were interposed before junction with a vein. It was noted that none of these capillaries anastomosed although they were considerably intertwined. They opened individually directly into stout venous trunks. It appeared that all four types were situated in the renal zones of specific function, the vessels being concentrated in the form of lacunae in the immediate vicinity of a thick venous trunk. It was felt that a very high osmotic pressure in these lacunae resulted in the reabsorption of water and electrolytes from the renal tubules in order to restore blood to normal prior to its return to the venous circulation.

The second group was divided into two subgroups, the first of which consisted of arterial formations passing directly into the venous system. The second subgroup showed arteries dividing into two or more arterioles before joining the venous trunk. However, in neither type were pre-venous capillaries demonstrated. This second group was always found in the region of the arcuate veins. It is believed to be designed to serve as a mechanism of defense against pathological injuries, in contradistinction to the first group, whose

main function is physiological. Should the kidney be in a state of blockade because of injuries which might alter the filtration and reabsorption in the previously mentioned lacunae, a method of conserving the renal economy is to divert the blood to make it flow directly into the renal vein to prevent nephron destruction.

The authors feel that their revelations open a vast new field for revision of normal physiology as well as for the interpretation of renal disease.

Twelve figures. EDWARD J. PAVSEK, M.D.
University of Pennsylvania

Aneurysm of the Hepatic Artery Demonstrated Roentgenographically. A Case Report. Luther Jarvis and Philip J. Hodes. Am. J. Roentgenol. **72:** 1037–1040, December 1954.

Arteriosclerotic changes with vascular calcification were found in only one-fourth of the 88 cases of hepatic artery aneurysm in the literature. No previous report apparently has stressed the roentgen manifestations of the lesion.

In the single case reported by the authors, the radiographic picture closely resembled a splenic artery aneurysm, except for the location. Calcification was demonstrable as globular, sharply defined densities, the peripheries being of eggshell character and the centers less dense and mottled. The picture might also have been mistaken for calcification in the wall of the gallbladder except that the calcific deposits lay closer to the spine than the usual gallbladder.

The case report is preceded by a brief but rather comprehensive review of the literature concerning hepatic artery aneurysm.

Two roentgenograms; 2 photographs.
E. E. TENNANT, M.D.
Sterling, Colo.

Serial Arteriography in Atherosclerosis. G. C. Willis, A. W. Light, and W. S. Gow. Canad. M. A. J. **71:** 562–569, December 1954.

The approach to the problem of atherosclerosis has been made previously through the pathological evaluation of large autopsy series. Progress of an individual atheromatous plaque cannot be followed by this method. An approach to this situation during life has been made by ophthalmoscopy but this visualizes arterioles instead of the larger caliber vessels.

Serial arteriography of the femoral and popliteal arteries was used to study the natural history of atheromatous plaques. Previous studies by Dow (Brit. M. J. **2:** 162, 1925) and others have correlated the degree of atherosclerosis in the large vessels of the inferior extremity with the degree of atherosclerosis present elsewhere and proved this approach to be valid.

This study was performed on males between the ages of fifty-five and seventy-seven with clinical manifestations of atherosclerosis. Bilateral femoral arteriography was done in all the cases, with 20 c.c. of 35 per cent Diodrast as the contrast medium. Five to seven exposures were made at intervals of one and one-half seconds, beginning when 10 c.c. had been injected.

Those patients demonstrating intimal plaques were divided into two groups—one for the study of the spontaneous changes in the arteries and the other for evaluation of response to treatment. The treated group was given 500 mg. of ascorbic acid three times daily.

Arteriography was repeated in two to six months and an unbiased observer compared the films. Estimation of the state of disease was based on change in the size of the intimal plaques. These showed both progression and regression, but the two never coexisted in the same case in a single period of observation. None of the untreated cases improved. In the treated group, 6 improved, 3 became worse, and 1 remained stationary. Formation of collateral circulation around areas of occlusion was demonstrated.

The authors suggest serial arteriography as a means of assessing the results of treatment in atherosclerotic lesions.

Three roentgenograms; 1 photograph; 2 tables.
O. R. ROTH, M.D.
Jefferson Hospital

Arterial Vascularization of the Soft Tissues of the Hand. Herbert Conway and Richard B. Stark. J. Bone & Joint Surg. **36-A:** 1238–1240, December 1954.

Following surgical intervention with undermining of flaps of skin of the palm of the hand, sloughing of soft tissue or delay in healing of the skin may occur. This is most common in the central portion of the palm. A study of the vascular supply to the skin and subcutaneous tissue of the palm was made by injecting thorium dioxide into the radial and ulnar arteries of both upper extremities of five cadavers. Following injection the skin and subcutaneous tissue were dissected cleanly from the deep fascia, palmar aponeurosis, and tendon sheaths. Roentgenograms were then made of the dissected specimens.

The study showed the arterial blood supply of the skin and subcutaneous tissue of the volar aspect of the hand to come from arterioles and capillaries running perpendicular to the surface of the skin. Only in the digits were vessels seen running longitudinal to the skin surface. Three zones of abundant vascularity were found. These were in the thenar and hypothenar regions and distal to the flexion crease of the palm. A triangular zone located in the center of the palm and bounded by these three areas showed a relative lack of arterial circulation.

The pattern of blood supply to the skin and subcutaneous tissue of the palm indicates that undermining of skin flaps should be limited to the minimum necessary to accomplish the purpose of any surgical procedure. If extensive undermining is necessary, the non-viable marginal tissue should be excised and coverage accomplished by skin grafts or pedicled flaps.

Three roentgenograms. RICHARD P. STORRS, M.D.
Syracuse, N.Y.

The Technique of Ascending Phlebography of the Lower Extremity. Torgny Greitz. Acta. radiol. **42:** 421–441, December 1954.

After a thorough clinical trial involving some 400 examinations, the author describes the technic of ascending phlebography of the lower extremity in the vertical position. This avoids the layering of blood and contrast medium seen in horizontal phlebography and in vertical phlebography when the blood flow is directed downward. Because of the possibility of the patient fainting during examination, the author has carried out the procedure at a 65-degree angle, which he has found practically equivalent to the vertical position.

It has been contended that great dilatation of veins

occurs when the leg is placed in a vertical position. While this is known to be true of superficial veins, the status of deep veins is more complicated. The difference in the diameter of the popliteal vein in the horizontal and vertical positions, in patients with venous insufficiency, was found to be less than 1 mm. in 10 out of 15 cases; it did not exceed 2 mm. in the remaining 5. In patients without venous insufficiency, the difference did not exceed 1 mm. These differences do not interfere with roentgenologic interpretation.

Thirty-five per cent Umbradil was found the most satisfactory medium, 60 c.c. being usually required. It is generally agreed that the puncture should be carried out as distally as possible, preferably on the dorsum of the foot. The medium should be injected within one minute through a relatively wide-bore needle, percutaneously. Various compression methods were attempted but these afforded no improvement in the diagnostic quality of the film and were found to jeopardize the flow of blood if improperly applied. Filling of the thigh and pelvis were aided when the patient carried out muscular movements immediately prior to filming.

About ten films are obtained in three minutes, with the use of two tubes, including right-angle films of the entire extremity and a single frontal view of the pelvis. There were no serious complications, and secondary ill effects occurred at the same rate as in intravenous pyelography.

Eleven roentgenograms; 2 diagrams.

DAVID C. GASTINEAU, M.D.
Indiana University

THE DIGESTIVE SYSTEM

Radiologic Examination of the Gastrointestinal Tract. John E. Gary and Richard Schatzki. New England J. Med. **251**: 1052–1058, Dec. 23; 1096–1102, Dec. 30, 1954.

In the section "Medical Progress," the more recent literature on radiologic examination of the digestive tract is reviewed.

The Esophagus: The authors introduce their consideration of the esophagus with references to Frank and Paul's report of the first case of duplication of the esophagus diagnosed before death, a study of 13 cases of this same anomaly from the Children's Hospital in Boston, and Blakemore's paper on the prognostic significance of portacaval shunt in varices.

Much interest has centered in recent years on the lower end of the esophagus, particularly its junction with the stomach. This is largely due to progress in thoracic surgery. A detailed discussion of the diagnosis of hiatus hernia is given, and numerous contributions to this subject are reviewed. In this connection the relation of esophagitis to hernia is considered at some length. There has been a tendency in recent years to stress reflux of gastric juice into the esophagus due to an incomplete closing mechanism at the esophageal gastric junction as a primary mechanism, and "reflux esophagitis" has become a well established entity. Since reflux is more common in patients with herniation of the stomach, a hiatus hernia is regarded as a predisposing factor for esophagitis, which may then result in ulceration and fibrosis.

Other reports cited, dealing with the esophagus, are that of Neuhauser and Berenberg on persistent vomiting in infants, caused by insufficiency of the normal hiatal closing mechanism ("chalasia"), and the recent descriptions by Ingelfinger and Kramer and by Schatzki and Gary on a group of patients with dysphagia in whom there is demonstrable a thin, smooth, concentric, diaphragm-like narrowing in the lower esophagus, about 5 cm. above the diaphragm. Schatzki and Gary believe that this ring represents the herniated esophagogastric junction and they regard the narrowing as due to inability of the junction to distend beyond a certain diameter. The origin of the condition is not known, but the clinical and roentgenologic pictures are characteristic.

The Stomach: Distention of the stomach with 500 to 1,500 c.c. of air introduced by a gastric tube after a single swallow of barium has been suggested as a means of gastric examination. This aids in the differentiation of normal mucosal folds from polyps and malignant tumors. Reference is made also to accounts of mass surveys of the stomach for the detection of cancer. A series of rapid fluoroscopic examinations performed on 2,413 persons fifty years of age or over in 1944 detected two carcinomas and one lymphosarcoma. Others have tried a purely radiographic approach, with a photofluorographic system similar to that used for mass surveys of the chest. At the present time the problem of mass surveys has not been solved, but studies continue, with some groups feeling that the practice is feasible, practical, and financially possible, while others believe that it is not too helpful in detection of unsuspected cancer of the stomach.

Other reports cited concern gastric varices in association with portal hypertension and esophageal varices, primary amyloidosis of the stomach, tuberculosis of the stomach and duodenum, and emphysematous gastritis.

Prolapse of the gastric mucosa into the duodenum has received widespread attention. The reported frequency ranges from 1.0 to as high as 50 per cent. The diagnosis is based exclusively on the radiologic findings. The authors feel that there is operative proof that prolapse of the gastric mucosa may occur but, since the clinical significance is questionable, they make the diagnosis rarely. They advocate watchful caution as the proper attitude.

The Duodenum: This section is brief, dealing particularly with ulcers, but mentioning also papers concerning hyperplasia of Brunner's glands and carcinoid tumors causing polypoid masses in the duodenal bulb.

The Small Intestine: Friedman and Rigler have recently described a triple lumen tube by means of which a segment of small intestine may be isolated between two inflated balloons and studied with barium or barium and air. The barium can be removed after completion of the study.

The practice of reducing ileocecal intussusception in children by barium enema, commonly done in Scandinavian countries, has recently found followers in this country. One series of cases reports successful reduction in 130 out of 162 cases without a death. A series of 22 reductions out of 32 cases has also been reported from the Johns Hopkins Hospital. The reduction is attempted with hydrostatic pressure; if it is unsuccessful the colon is allowed to empty and the procedure is repeated. The opinion that it is impossible to reduce bowel that is gangrenous is unanimous.

Papers on perforation of the small bowel, disturbed motor physiology, and regional enteritis, and a monograph on ileus are briefly reviewed.

The Colon: Recent improvements in the roentgen examination of the colon have concerned not so much innovations as more accurate and conscientious application of old technics. The use of tannic acid in the barium mixture and double contrast studies of the colon have become more widely used. Thinner barium mixtures and higher kilovoltages have been advocated for making the barium-filled colon more translucent.

A description of mucocele of the appendix is given and the significance of fecaliths of the appendix is discussed. Papers on the x-ray diagnosis of volvulus of the cecum, volvulus of the sigmoid, ulcerative colitis, and Hirschsprung's disease are cited.

The Biliary System: There has been further improvement in cholecystography, one of the most reliable radiologic examinations. The use of Telepaque has resulted in denser gallbladder shadows with fewer side effects. Operative and postoperative cholangiography are becoming increasingly popular. Probably the most important step forward has been the introduction of a new intravenously administered contrast medium. First used in Germany, it is now available in the United States under the name of Cholografin.

Study of the liver and pancreas continues to be unsatisfactory. Search for a non-toxic, non-radioactive substance that will opacify has been unsuccessful. Thorotrast has been abandoned not only because of its carcinogenic tendency but because its radioactivity produces hepatic fibrosis.

The papers covered in this comprehensive review will be found in RADIOLOGY, either in the original or as abstracts.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Gastrointestinal Motility in Man. Influence of a Standard Meal on the Effect of Banthine. William P. Chapman, Stanley M. Wyman, Jacques Gagnon, Chester M. Jones, and Grace L. Puleo. New England J. Med. **251**: 965–970, Dec. 9, 1954.

Motor studies with barium meals were carried out on 24 adult male subjects. All were healthy, except that 2 had a history of previous peptic ulcer. The method was that used in an earlier study (Gastroenterology **23**: 234, 1953. Abst. in Radiology **61**: 966, 1953). Each of the patients was examined after oral administration of Banthine in 100-mg. and 50-mg. doses, and placebos in the form of tablets resembling Banthine in appearance and taste. The effects were tested with the subjects fasting, and again when a standard meal had been given half an hour after the administration of the agents. Each patient, therefore, received six separate examinations.

Gastric evacuation was delayed by the administration of Banthine (more so by 100 mg. than by 50 mg.). There was significantly more delay in gastric evacuation in the placebo and 50-mg. tests when the meal was given half an hour after these agents than when no meal was administered. This finding is considered by the authors to result from the increased bulk present in the stomach as a consequence of the ingestion of the meal, but they cannot explain why the meal made no difference in the tests with 100 mg. of Banthine.

The inhibitory effect which Banthine produces on the forward movement of the head of the barium column along the intestine was found to be lessened by the taking of the meal. Banthine in both dosages caused significantly more delay in intestinal propulsion during the fasting tests.

Dry mouth, and to a lesser extent dry nose, were the only prominent side effects from Banthine. The taking of the standard meal was associated with significantly less dry mouth in the 50-mg. but not in the 100-mg. tests. The agents demonstrated no significant clinical effect on blood pressure level, heart rate, or temperature of the finger tips.

The authors suggest that their experiments indicate that either 50 or 100 mg. of Banthine combined with food may retard gastric evacuation in ulcer patients, and that the presence of a meal appreciably diminishes the effectiveness of Banthine given to retard the forward movement of food in the intestine.

Four figures; 1 table.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Unsolved Problems in the X-Ray Diagnosis of Peptic Ulcer. The Atropine Test. E. Ötvös. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 749–757, December 1954. (In German)

In spite of the high development of examination of the gastric and duodenal mucosal pattern, the diagnosis of peptic ulceration remains uncertain in some cases. In order to improve the situation, the author injects 0.5–1.0 mg. atropine sulfate subcutaneously and performs the gastrointestinal examination under the full effect of the drug two hours later. Atropine has no effect on the normal human stomach. On the other hand, in cases of intramural inflammation of the stomach and duodenum the drug produces a characteristic dyskinesia, with a significant gastric retention in spite of good peristalsis. Such a positive atropine test is found with the following conditions: (1) chronic duodenal ulcer with callus, as evidenced by history, deformed bulb, periduodenitis, localized tenderness, and a suspicious niche; (2) a large gastric residue, with almost complete lack of bulb filling, suggesting an ulcer near the pylorus, with probably beginning organic stenosis; (3) marked gastritis-duodenitis mucosal relief, without bulb deformity or niche, with or without tenderness, indicating a deep inflammatory process of the stomach and duodenal wall. A negative test is obtained under the following conditions: (1) duodenal crater without a deformed bulb (probably a superficial acute ulcer); (2) an old deformity; (3) periduodenal adhesions without definite bulb deformity, due to extragastric causes, such as a subsiding cholecystitis.

Two roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Leiomyoma of the Stomach. Herbert L. Abrams. Am. J. Roentgenol. **72**: 1023–1033, December 1954.

A review of the literature, evaluation of the findings in 5 cases, and analysis of reports of 50 collected examples of leiomyoma of the stomach are presented in an attempt to increase diagnostic acuity relative to these benign gastric tumors. In correlating the sources of information, the author discusses the subject comprehensively and concisely.

Leiomyoma of the stomach is the most common benign gastric neoplasm, representing 27 to 70 per cent of various reported series. The higher incidence in autopsy studies as compared with radiographic and surgical reports may be due to the small size of many of the lesions. Pathologically the tumors may be submucosal or subserosal, the former being more common.

The well defined tumors vary considerably in size. The location seems to be equally divided between the pylorus and cardia.

Gastric leiomyomas may produce hemorrhage, epigastric pain, weight loss, a palpable mass, or pyloric obstruction. Many are asymptomatic. Roentgenographically the tumors present a circumscribed filling defect over which the rugae are obliterated. Adjacent folds are normal, and alteration in peristalsis is evident. An ulcer niche is frequently present. Compression may be necessary to reveal the tumor in an overfilled stomach.

Eleven roentgenograms; 3 photographs; 2 photomicrographs.

E. E. TENNANT, M.D.
Sterling, Colo.

Boeck's Sarcoid of the Stomach Simulating Linitis Plastica. Report of a Case and Comparison with Twelve Recorded Cases. Howard D. Sirak. Arch. Surg. **69**: 769–776, December 1954.

A single case of Boeck's sarcoid of the stomach is presented and 12 cases from the literature are reviewed. Symptomatology and roentgenographic findings mimick gastric ulcer or carcinoma. Absence of free hydrochloric acid in gastric secretions was noted in all but one patient. Grossly the rubbery, elastic edematous gastric wall in the author's patient helped differentiate the disease from carcinoma. Cortisone therapy produced a remission of symptoms without a change in roentgenographic findings. Symptoms returned upon withdrawal of the drug.

One roentgenogram; 3 photomicrographs; 1 table.

RICHARD E. BUENGER, M.D.
Chicago, Ill.

Hyperplasia of Brunner's Glands. A. A. Epstein and L. J. Cole. J. Canad. A. Radiologists **5**: 43–45, December 1954.

The authors report a case of hyperplasia of Brunner's glands, which they state is the fourth case to appear in the literature. (For the others, see Erb and Johnson: Gastroenterology **11**: 740, 1948. Abst. in Radiology **53**: 604, 1949; Dodd *et al:* Radiology **60**: 817, 1953.) The patient complained of six years of epigastric distress following meals, which was relieved by vomiting. Physical findings, aside from epigastric tenderness, were negative. Gastric analysis disclosed moderate hypersecretion and hyperacidity. A gastrointestinal series disclosed a polypoid appearance of the duodenal bulb. Only transient relief was obtained on an ulcer regime, and a repeat roentgen study showed no change. At operation the duodenal mucosa was found to be heaped up, almost obliterating the lumen. Gastroenterostomy and vagotomy were performed. Biopsy studies confirmed the gross impression of hyperplasia of Brunner's glands.

The author states that the x-ray findings were identical with those described by Dodd *et. al.*, namely, multiple, sharply defined filling defects, chiefly within the bulb, but extending into the descending limb. The condition is to be differentiated from polyps and tumors, which are usually solitary, occasionally with a pedicle. Duodenitis differs in that the bulb is usually irritable, the defects change in size, shape, and position, they can be obliterated by pressure and regress under treatment.

Three roentgenograms.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

The Distribution of Air in the Intestinal Tract of Infants During the First Twelve Hours as Determined by Serial Roentgenograms. Morton L. Podolsky and Albert W. Jester. J. Pediat. **45**: 633–642, December 1954.

The authors have sought, by serial roentgenograms in the same infant, to correlate the appearance of air in the several portions of the intestinal tract with age (in hours). Healthy newborn infants, full-term and premature, were permitted to remain undisturbed until a normal respiratory pattern was observed. In the first group of 14 babies, anteroposterior and lateral roentgenograms of the abdomen were made hourly until six hours after birth. The second group was examined roentgenographically as soon after birth as was practicable and were followed thereafter at two-hour intervals for a total of ten to twelve hours. Other infants received their first examination shortly after birth and were re-examined at three-hour intervals.

A total of 133 x-ray examinations were made on 35 newborn infants, 9 of which were premature. All of the 35 showed air in the stomach and small bowel on the first film. Between the third and fourth hour, 13 out of 14 infants, or 93 per cent, showed air in the cecum or ascending colon, with a rise to 100 per cent at five to six hours. Air was also noted in the transverse and descending segments of the colon in 100 per cent of the babies at five to six hours. This percentage fell off in the next two hourly interval, then rose again to 100 per cent at the eight-hour interval, and remained there throughout the rest of the study. Air was not seen in the sigmoid in 100 per cent of the infants until the eighth to ninth hour. Air in the rectum was exceedingly variable. From birth until six hours it rose gradually to 36 per cent, then fell to 7 and 0 per cent, at seven and eight hours, respectively, rising to 75 to 100 per cent at ten and twelve hours, followed by another decline.

On the whole, the highest incidence of air in all segments of the intestinal tract was encountered between four and six hours, and again at eight to eleven hours. This is best explained by the assumption that air probably progresses through the entire intestinal tract within the first four to six hours. It is then passed as flatus and disappears from the sigmoid and rectum. At eight to eleven hours it re-accumulates in the distal segments.

There is a marked though not constant tendency for premature infants to show a more rapid progression of air, as compared with those born at term.

Ten roentgenograms; 3 charts; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California, S.F.

Enterogenous Cyst of the Duodenum. Report of a Case and Review of the Literature. Karl Mendl and Clive H. Tanner. Brit. J. Radiol. **27**: 699–703, December 1954.

Only 19 cases of enterogenous cyst of the duodenum have been recorded. The authors add another, in a 57-year-old man who complained of sudden attacks of vomiting and epigastric pain. Roentgen examination showed considerable gastric residue. There was a large filling defect arising at the right wall of the duodenum, with smooth and rounded border. The junction of the tumor and duodenal wall was not clear-cut. The horizontal mucosal folds were compressed and not disorganized. The relationship of the lesion to the gallbladder and biliary ducts was established by chole-

cystography and simultaneous contrast filling of the duodenal lumen. While the x-ray findings favored a diagnosis of benign tumor, *i.e.*, myoma, adenoma, lipoma, etc., a malignant lesion could not be ruled out.

Laparotomy revealed a soft swelling, about 2½ inches in diameter and 3 inches long, in the lateral wall of the descending part of the duodenum. The pylorus was markedly hypertrophied, and the obstruction was obvious. The duodenal mucosa over the swelling was intact and not eroded. At this stage of the operation, the swelling burst, discharging a clear watery fluid, and a diagnosis of enterogenous cyst was made.

Three roentgenograms; 1 photograph; 1 photomicrograph.

Perforation of the Colon in Ulcerative Colitis. Charles B. Ripstein. Ann. Surg. **140:** 872–874, December 1954.

The author stresses the seriousness of a perforation in ulcerative colitis and the necessity for surgical intervention. He feels that extensive primary resection of all the involved bowel, even in the presence of peritonitis, is indicated in order to remove the focus of infection. This segment of bowel is considered a source of blood and protein loss as well as toxemia, causing a downhill course in spite of antibiotics.

Perforation is most frequent in acute fulminating ulcerative colitis. Twelve perforations occurred in the author's series of 142 operative cases, 8 during acute exacerbations of the colitis. Radiographically a distended segment of colon, without small bowel distention, was interpreted as a sign of impending perforation.

The treatment proposed is primary resection of the colon and ileostomy. This would seem to be justified by the author's results—1 surgical death in 11 cases.

Two roentgenograms; 1 photograph.

G. R. HANSON, M.D.
Cleveland City Hospital

Primary Malignancies of the Papilla of Vater. Case Report and Review. Austin P. Boleman, Jr., and Leonard Breslaw. Gastroenterology **27:** 869–878, December 1954.

The authors review the cases of malignant neoplasms of vaterian origin seen at the Lenox Hill Hospital (New York) in the past twenty years, adding a case of their own. A total of 8 cases are tabulated.

No one initial symptom was pathognomonic of this lesion. However, 7 of the 8 patients were icteric on admission and a similar number had complaints referable to the abdomen. Except in 2 patients who had previously undergone cholecystectomy and 1 who had chronic cholecystitis and cholelithiasis, the gallbladder was enlarged and palpable.

Gastrointestinal series were non-contributory in 4 of the 5 patients so examined. The authors' case displayed an intrinsic filling defect in the second portion of the duodenum. Guaiac-positive stools were demonstrated in the 5 cases examined.

The average age of the patients was 63.4 years, with a range from fifty-four to seventy-six years. The majority succumbed within seven months of the onset of symptoms.

Two roentgenograms; 1 photograph; 1 photomicrograph; 1 chart; 4 tables.

G. R. HANSON, M.D.
Cleveland City Hospital

Solitary Calculus of the Duct of Wirsung. Robert B. Johnson and Harvey W. Baker. Gastroenterology **27:** 849–860, December 1954.

The authors review the literature on calcific deposits in the pancreas and discuss the etiology of multiple and solitary calculi. The former are generally believed to be secondary to an inflammatory process. The origin of the latter remains a matter of theory.

Sphincterotomy or diversion of the biliary flow is recommended to obviate the repeated irritative insults of reflux bile felt to be causal in pancreatitis. A solitary calculus without clinical evidence of pancreatitis may be successfully treated by pancreatolithotomy.

The case reported was treated in this manner, following extensive preoperative stool and secretory studies. These supported the x-ray findings of a calculus in the region of the head of the pancreas. No difficulties were encountered in the surgical procedure and postoperative improvement occurred.

In view of the clinical improvement in this case, the authors believe that pancreatolithotomy may well be a logical procedure for treatment of solitary calculi of the duct of Wirsung in the absence of pancreatitis.

Four roentgenograms; 1 photograph; 4 graphs; 2 tables.

G. R. HANSON, M.D.
Cleveland City Hospital

Gall Bladder Function (Cholecystographic Studies) Following Nonspecific Trauma. The Systemic Response to Trauma. John M. Howard. Surgery **36:** 1051–1055, December 1954.

As part of a study on bodily response to trauma, cholecystograms were obtained with Priodax, Telepaque, and Iodeikon on several normal control patients and on 22 patients injured in battle.

With few exceptions, temporary non-visualization of the gallbladder was found to occur following severe injury to any part of the body. No relation appeared to exist to the type of anesthesia, the anesthetic agent, or the site of injury. Hepatic function tests revealed normal liver excretory function in cases of gallbladder non-visualization. Gastrointestinal absorption appeared not to be basically important, as the gallbladder failed to visualize following intravenous administration of the medium. The response seemed rather to be due to primary failure of gallbladder function.

It is suggested that following injury the gallbladder takes part in gastrointestinal paralytic ileus, fails to empty, and may also fail to absorb water from the bile. The duration of the response appears to depend upon the severity of the injury.

The findings strongly suggest that the gallbladder participates in the body's response to injury.

One table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

THE MUSCULOSKELETAL SYSTEM

Metaphyseal Dysplasia, Epiphyseal Dysplasia, Diaphyseal Dysplasia, and Related Conditions. I. Familial Metaphyseal Dysplasia and Craniometaphyseal Dysplasia; Their Relation to Leontiasis Ossea and Osteopetrosis; Disorders of "Bone Remodeling." W. P. U. Jackson, Fuller Albright, Garth Drewry, Joseph Hanelin, and Mitchell I. Rubin. Arch. Int. Med. **94:** 871–885, December 1954.

Familial metaphyseal dysplasia appears to consist essentially of a symmetrical expansion of the metaph-

yses of the long bones. In these regions the cortex is excessively thin, the bone being of uniform appearance throughout and poorly mineralized, with smudgy, coarse trabeculation. The normal differentiation between cortex and medulla is lost. The lower end of the femur resembles an Erlenmeyer flask in shape, due to failure of constriction which normally occurs during the development of a bone. Normal tubulation of the affected bone occurs only in midshaft, where the cortical bone may be a little thickened. The tubular bones may be involved at both ends or at one end only; the determining factor seems to be whether the metaphysis in question normally decreases in circumference as it moves shaftward from the epiphysis. The metacarpals and phalanges, having a single epiphysis and metaphysis, demonstrate evidence of widening limited to the metaphyseal end of the bone.

The femur, tibia, and fibula may be abnormally long. The bones also bend, the femur bowing forward and the tibia describing an S-curve or a reversed S.

The epiphyses appear normal; bone age is not affected; general health does not suffer; anemia does not develop; and teeth are not abnormal.

Three cases of metaphyseal dysplasia occurring in one family are presented. In this family generalized osteoporosis accompanied the metaphyseal disturbance.

In craniometaphyseal dysplasia, the typical tubular bone changes of metaphyseal dysplasia are combined with severe sclerosis and overgrowth of all bones of the skull (leontiasis ossea). Two cases are reported.

Osteopetrosis is a more familiar example of defective metaphyseal bone remodeling. The bones are similar in shape to those in metaphyseal dysplasia and the differentiation between cortex and medulla is lost. The facial bones may be involved. A single case of this condition is reported.

Solely on a clinical basis these three conditions appear to be related.

Seventeen roentgenograms; 7 photographs; 2 drawings; 2 charts. HOWARD L. STEINBACH, M.D.
University of California, S. F.

Metaphyseal Dysplasia, Epiphyseal Dysplasia, Diaphyseal Dysplasia, and Related Conditions. II. Multiple Epiphyseal Dysplasia; Its Relation to Other Disorders of Epiphyseal Development. W. P. U. Jackson, Joseph Hanelin, and Fuller Albright. Arch. Int. Med. **94:** 886–901, December 1954.

Multiple epiphyseal dysplasia is a developmental clinical entity, consisting essentially in irregularity in form and structure of the developing epiphyses, which usually appear two to three years late. Multiple centers of ossification may develop at different times in the same epiphysis, but the extreme stippling of punctate epiphyseal dysplasia does not occur. The affection is bilateral and nearly symmetrical. It progresses toward consolidation, so that successive roentgenograms demonstrate improvement with age. Epiphyseal union is generally little delayed. After puberty some abnormality of epiphyseal shape or joint angulation may suggest the previous cartilaginous dysplasia. The bone in adult life is well ossified and of good structure. The epiphyses are affected at the hips, shoulders, knees, elbows, wrists, and ankles. Carpal and tarsal bones, metacarpal and metatarsal heads, phalangeal epiphyses, and the patella may be irregular and stunted. The spine is frequently normal, but the bodies may be reduced in height and epiphyseal plates may be irregular.

Clinically, there may be difficulty in walking, with structural deformity, such as coxa vara and genu valgum. The hands are typically short and stubby, with narrow, squat nails. On the whole there is remarkable freedom from symptoms. The patients do not grow beyond 5 feet in height. A single roentgenogram of one epiphysis (as the hip) may resemble that of cretinism, Morquio's disease, or juvenile osteochondritis (Legg-Perthes disease), with which this dystrophy has been confused. The clinical observations and roentgen examination of the whole skeleton will readily make the differentiation.

Several examples of this syndrome are reported, including 4 in one family. Two of the cases were unusual in having particularly severe localized vertebral changes, and 2 showed continued fragmentation of single femoral epiphyses in adult life.

Thirty roentgenograms; 9 photographs; 1 chart.
HOWARD L. STEINBACH, M.D.
University of California, S. F.

Metaphyseal Dysplasia, Epiphyseal Dysplasia, Diaphyseal Dysplasia, and Related Conditions. III. Progressive Diaphyseal Dysplasia. W. P. U. Jackson, Joseph Hanelin, and Fuller Albright. Arch. Int. Med. **94:** 902–910, December 1954.

Progressive diaphyseal dysplasia, or "Engelmann's disease," is characterized by symmetrical fusiform expansion of the mid portions of the diaphyses. Sometimes two separate diaphyseal foci of bone expansion are seen in the femora or in the tibiae, with the intervening shaft less intensely involved or almost totally spared. The outlines of the abnormal portions of bone are usually smooth, but the bone pattern is amorphous in texture and of irregular density, with loss of normal trabecular structure and frequent effacement of cortical and cancellous differentiation. The new bone is both endosteal and periosteal. The skull often shows increased density and thickening at the base or in the vault. The clavicle may also be involved. The hands, feet, spine, and pelvis were not affected in any of the previously reported cases. The condition is progressive for as long as any case has so far been followed, with spread of the osseous changes proximally and distally in each long bone to involve almost all of the diaphysis. The epiphyses are uniformly spared. Epiphyseal development and bone age remain normal. The syndrome is apparently not usually hereditary.

Two cases are presented, with follow-up studies obtained after a five-year interval. In one patient there was comparatively little progression during the five-year follow-up; in the other patient the bone changes at the end of that period were more severe than have previously been reported in any case of this condition.

Roentgenograms demonstrate two essential processes in diaphyseal dysplasia: (1) the laying down of excessive new endosteal and periosteal bone and (2) irregular conversion of this cortical bone into cancellous bone. Sometimes this second resorptive process goes so far as actually to thin the cortex.

Twenty roentgenograms; 2 photographs.
HOWARD L. STEINBACH, M.D.
University of California, S. F.

Echinococcus Disease of Bone. Report of a Case. David C. Kellsey and Harry F. Sproat. J. Bone & Joint Surg. **36-A:** 1241–1248, December 1954.

Echinococcus disease of bone is rarely seen in the

United States. Man is a relatively uncommon intermediary host but may be infected by ova-containing excreta of dogs, especially in the sheep-raising areas. About three weeks after the embryos reach their definitive organ or tissue in the intermediary host they develop into the larval or cystic form. In the bone, because of its structural characteristics, microcysts are formed rather than the large single cysts that are commonly seen in the liver. The hydatids infiltrate, destroy, and replace the bone, finally breaking through the cortex to produce extra-osseous signs.

Ordinarily bones are first involved by the arterial route after the embryos have passed through the filters of liver and lungs. Clinical and roentgenographic signs of hydatid infection of bone are late in appearing. The first stage consists of invasion of the relatively well vascularized area of the epiphysis. Roentgenograms at this stage may show multiple small cyst-like spaces limited by thin trabeculae. There is very little bone reaction early but later, as a result of prolonged irritation, hyperostosis predominates over osteolysis. A valuable point in diagnosis is the absence of sharp demarcation between normal and diseased areas. Pathologic fractures may occur after the bone cortex is thinned. Conditions to be differentiated include osteogenic sarcoma, giant-cell tumor, osteitis fibrosa cystica, vertebral angioma, and Paget's disease.

The Casoni skin test is a reliable diagnostic aid. The complement-fixation test of Weinberg is more difficult to perform but may be helpful in doubtful cases. Eosinophilia is present in active hydatid disease.

There is no known specific treatment. Excision is probably the best measure, but there is danger of anaphylaxis during the procedure and also the possibility of further implantation of the hydatids. Local excision followed by packing with bone chips has been used as well as amputation.

A case is reported in a 53-year-old male, who had worked with sheep in Puerto Rico in his youth. His army service had included tours in Panama and in France. He complained of generalized, vague, aching pain and a sense of weakness of the left arm and elbow of three weeks duration. On physical examination the left humerus felt wider than the right. There was a persistent eosinophilia of 3 to 6 per cent. The complement-fixation test for echinococcus was negative. The Casoni test was not done. Roentgenograms of the left humerus showed thickening of the cortex and multiple areas of radiolucency involving the entire bone. A biopsy of the distal portion of the left humerus produced a block of dirty appearing, streaked, gray bone. Microscopic study showed many microcysts in the marrow space and within bone lacunae. The remaining marrow space was occupied by fibrous tissue with lymphocytic infiltration. Some granulomatous areas with giant cells were noted. The appearance was that of a microcystic process with an internal germinal layer consistent with hydatid disease. The reaction of the bone was that of pressure atrophy. No further therapy was carried out.

Two roentgenograms; 6 photomicrographs.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

The Radiologist and Athletic Injuries. Everett F. Crutchlow. J. Canad. A. Radiologists **5**: 52–53, December 1954.

In this preliminary paper the author records the diagnostic results of 1,112 x-ray examinations of injuries in competitive sports. Three hundred and ninety-six, or 35.5 per cent, showed signs of recent or previous trauma, while the remainder were negative. Incidence of recent and old trauma was found to be about equal. The author advocates routine roentgen study of injured areas because athletes have a high threshold of pain and may not recognize serious injury for several hours. No significant difference was found in injury incidence between professional and amateur athletes.

The nasal bones showed the highest incidence of fracture, 34 cases. Separation of the acromioclavicular joint was the second most frequent injury, 15 cases. There were 10 fractures of the first metacarpus and an equal number of the transverse processes of lumbar vertebrae. Chip fractures of fingers, fractures of the lateral malleolus, and myositis ossificans were each seen 6 times. Five instances each of scaphoid and fibular fracture occurred. Other common injuries included subcoracoid dislocation of humerus (5), fracture of the maxilla (5), sternoclavicular separation (4), fracture of the ulnar styloid (4), and bimalleolar fracture (posterior and lateral) (4). Infrequent were compression fractures of cervical and dorsal vertebrae (2 each), fractures of the skull (2), ribs (2), humerus (1), and radius (1), Colles fracture (1), and pneumothorax (1). No fractures of the pelvis, femur, shaft of the ulna, or lumbar vertebral bodies were seen.

Injuries by regions, in order of frequency, were: shoulder and upper extremity, 51; face and skull, 45; pelvis and lower extremity, 17; axial skeleton, 14; thorax and soft tissues, 9.

The author studies all knee injuries by Urokon arthrography. He believes all old cases of meniscus injury show hypertrophic arthritic changes. He includes acute duodenal ulcer occurring in coaches as an athletic injury.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Roentgen Demonstration of Cervical Nerve Root Avulsion. John E. Whiteleather. Am. J. Roentgenol. **72**: 1017–1022, December 1954.

Injury to the cervical nerve roots may be either intra- or extraspinal. Cervical myelography offers a quick, relatively easy, and accurate method of demonstrating avulsion or root tear within the foramen, and thereby allows assumption of an extraspinal injury by exclusion. It has the additional advantage that it can often be employed early, even when fractures or soft-tissue lacerations hinder or prevent accurate neurological evaluation.

Two distinct radiographic appearances are observed in intraspinal or intraforaminal nerve root avulsion. One consists of extradural collections of oil in pockets or pseudodiverticula which lie along side of or project into the intervertebral foramina, representing a tear in the dura left by the avulsed root. The second is less obvious. It is a tiny niche or smooth straight contour at the site of normal root shadow. This indicates complete avulsion of the root.

The author presents 9 detailed radiographic studies to demonstrate these findings. He feels that correlation of surgical findings with a history of trauma and the proper neurological defect may be associated with the myelographic abnormalities to allow a pathognomonic diagnosis and thereby prevent an attempt at worthless surgical exploration.

The discussion following presentation of this article is extremely interesting regarding possible differential diagnosis of the described findings and arachnoid cysts. It is pointed out that this is an original radiographic description of a new entity and that more cases will be required to establish the definitive conclusion presented by the author.

Eight roentgenograms. E. E. TENNANT, M.D.
Sterling, Colo.

Diastematomyelia. Report of a Case Diagnosed Preoperatively. William R. Chambers. J. Pediat. **45**: 668–671, December 1954.

Diastematomyelia consists in a congenital cleft of the spinal cord, through which there usually extends a spicule of bone or a fibrous band on which the cord is impaled and fixed. The cord is often transfixed in its low-lumbar fetal position rather than its dorsolumbar adult position, being held down by the bone or band. It is the traction on and splitting of the cord by the impaling object which appears to produce the frequently associated neurological deficit. A case is presented in which the correct diagnosis was established prior to surgery.

The patient was a three-year-old child who tended to hold the right lower extremity in external rotation while walking. Examination of the back revealed a prominence at the lumbosacral area and slightly to the left and overlying the left buttock. There was atrophy of the left buttock, calf, and thigh. The Babinski reflex was positive on the left side. Roentgenograms revealed a large spina bifida below the level of L-2, extending throughout the sacral region. A hemivertebra was present in the mid-lumbar area and a small bony spicule was seen at the level of the third and fourth lumbar vertebrae. Myelography revealed a central defect of the Pantopaque column, which was diagnostic of the abnormality.

Four roentgenograms; 2 drawings.
HOWARD L. STEINBACH, M.D.
University of California, S. F.

A New Observation in a Case of Hyperostotic Osteopathy of Engelmann-Camurati. H. Weingraber. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 800–804, December 1954. (In German)

Engelmann's disease, or osteopathia hyperostotica, is an unusual condition with dominant monohybrid inheritance, first described in 1929. The author's patient was a 4-year-old boy with clumsy nautical gait, relatively long extremities, and atrophic musculature. The history was essentially negative except that walking was delayed until the sixteenth month. The blood picture disclosed a moderate anisocytosis and hypochromic anemia as well as a slight leukocytosis. The sedimentation rate was elevated. A bone marrow biopsy showed marked fibrosis.

The roentgenologic study revealed a symmetrical generalized thickening of the diaphyses with periosteal sclerosis and an irregular lattice-like structural change in the substancia compacta with either narrowing or widening of the marrow cavity. The base of the skull, frontal and parietal bones, and upper and lower extremities were involved, and possibly the fingers and ribs as well. Progressive onion-skin periosteal layers were observed, separated from the compact substance by narrow radiolucent stripes, as in osteomyelitis or Ewing's sarcoma. This picture has never been described previously. Examination after a two-month interval showed the onion-skin layers partly consolidated, but new deposits were encountered elsewhere. The increase in shaft thickness averaged 3 mm. in this interval.

Because of the similarity of this periostitic process to that found in irritative myelogenous conditions, the supposition is natural that here also we are dealing with an insidious hemopoietic process which is manifested as a marrow fibrosis.

Seven roentgenograms.
CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Acromial Apophysitis, a Rare Osteochondropathy. F.-K. Landgraf. Fortschr. a. d. Geb. d. Röntgenstrahlen **81**: 797–800, December 1954. (In German)

In spite of many references in the literature to juvenile osteochondropathies of rare location, only two references were found dealing with ossification disturbances in the acromial apophysis, and only one with an associated clinical picture.

The author's patient was a 16-year-old baker's apprentice who complained of pains in both shoulders for several weeks. A tender swelling was present over the left acromioclavicular joint, and to a less extent over the right. Function in both shoulder joints was good. Roentgenograms showed both acromial apophyses to be small, segmented, irregularly contoured, and irregularly ossified. Rest was prescribed, and after three months there was no longer any clinical abnormality and the apophyses appeared normal.

Just as in the ischiopubic synchrondrosis, unusual radiologic appearances may be found in clinically normal children. The author concludes, therefore, that bizarre ossification may occur normally and does not by itself justify a diagnosis of acromial apophysitis.

Two roentgenograms.
CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Hematoma of Rectus Sheath. Geoffrey Mizbah. Am. J. Surg. **88**: 964–966, December 1954.

A case of a hematoma of the rectus sheath which simulated an intraabdominal cyst is presented. A 63-year-old female complained of acute pain in the left hypochondrium of a day duration, first appearing after forceful coughing. A tender mass could be palpated in this region. A survey roentgenogram revealed an abnormal shadow located anteriorly in the left side of the abdomen. On examination by barium meal, the proximal loops of jejunum appeared to surround the tumor partially.

The preoperative diagnosis suggested was mesenteric cyst. At surgery, a hematoma was found between two layers of the rectus sheath. It was felt that the hematoma resulted from rupture of a blood vessel due to the severe bout of coughing.

Two roentgenograms. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

GYNECOLOGY AND OBSTETRICS

The Diagnosis of Tubointestinal and Tubovesical Fistulas by Hysterosalpingography. Samuel Rozin. Am. J. Obst. & Gynec. **68**: 1525–1534, December 1954.

Four cases of tubointestinal and 1 case of tubovesical

fistula diagnosed by hysterosalpingography are presented and well illustrated.

These internal tubal fistulas are rarely diagnosed by clinical signs, usually being discovered unexpectedly at laparotomy. An adhesion of a pyosalpinx to one of the adjacent hollow viscera with subsequent breaking down of the separating wall is the usual mechanism of development.

Tubal fistulas may develop after inadequate surgery. Adnexal tuberculosis is the most important etiological factor in both the spontaneous and postoperative type. In the 4 cases reported here a tuberculous origin was suspected but was confirmed by histological examination in only 1 and suggested by the roentgenograms in 2 other cases.

The characteristic x-ray findings in cases of tubointestinal and tubovesical fistulas are as follows:

a) The lumen of the involved tubes is usually enlarged, without evidence of peristalsis, and distorted in abnormal position.
b) The lumen of the tube abruptly enlarges to form an unusually large and uneven space.
c) The control film taken after one or more hours reveals the opaque material assuming the shape of the intestine and coating the mucosal folds.
d) Within the bladder the Lipiodol forms droplets, changes as the position of the patient changes, and suddenly disappears if the patient urinates.

Fourteen roentgenograms. ROBERT L. EGAN, M.D.
M. D. Anderson Hospital, Houston

THE GENITOURINARY SYSTEM

The Use of a Short Acting, Muscle Relaxant Drug (Succinylcholine Chloride) in Diagnostic Urography: A Preliminary Report. D. R. Dick, R. W. Herrmann, Charles Ferguson, and C. L. Hebert. J. Urol. **72**: 1260–1262, December 1954.

In order to obtain good pyelograms while the patient is under general anesthesia, it is necessary to control respiration. This is often accomplished by giving large amounts of thiopentol or curare rapidly, or by inducing hyperventilation with resulting apnea. Some of the dangers of these methods are avoided by using Anectine (succinylcholine chloride). The action of this drug commences about twenty to forty seconds after intravenous injection and it is effective for three or four minutes. Following doses of 10 to 30 mg., a period of apnea averaging about seventy-eight seconds was noted in the 13 cases reported by the authors. An anesthesiologist skilled in positive pressure oxygenation and emergency intubation should be present during the procedure.

One roentgenogram; 1 graph.
W. WILLIAM NAGLE, M.D.
University of Pennsylvania

The Correlation Between Contrast Excretion and Arterial and Intrapelvic Pressures in Urography. An Experimental Study in Rabbits. N. P. G. Edling, C. G. Helander, and L. Renck. Acta radiol. **42**: 442–450, December 1954.

The authors demonstrated in experiments on rabbits that the nephrographic effect in urography depends upon the variations in the arterial and intrapelvic pressures. The effect is dependent, in the main, on the function of the tubular cells and, to a lesser extent, on the filtration of the glomeruli. With a lowering in the systolic blood pressure, the contrast medium accumulates in the kidneys and the filling of the pelvis ceases. Increase in the intrapelvic pressure in one kidney by means of counterpressure in the ureter, with consequent reduction in the filtration pressure of the glomeruli, produces the same impairment of the excretion of the contrast medium.

These findings indicate that the nephrographic effect in urography is caused by decrease in the intraglomerular or increase in intrapelvic pressures—as occurs in human subjects in shock or stasis.

Fifteen roentgenograms; 5 blood pressure curves.
WILLIAM M. LOEHR, M.D.
Indiana University

Urinary Tract Calculi in Children. Renal and Vesical Calculi in an Eight-Month-Old Child. C. A. Moore and C. C. Dodson. Am. J. Dis. Child. **88**: 743–748, December 1954.

While a review of the literature reveals a report of a bladder calculus in a six-month fetus and a report of a renal calculus in a newborn infant, the overall incidence of urinary calculi in infants and children is relatively low in the United States, particularly below the age of five. The reported incidence varies from 0.15 per cent in a group of children with chronic pyuria to 25 per cent in some 3,000 cases of vesical calculi reported from China. Urinary tract calculi occur predominantly in male children; for vesical calculi the ratio is 9 males to 1 female. Possible etiologic factors are the same in children as in adults, namely, vitamin A deficiency, excessive crystaloid excretion, infection, and calcium plaque formation.

The symptoms and signs of urinary tract calculi are the same in all age groups, but the diagnosis may be more difficult in children because of the greater difficulty of obtaining a reliable history.

The occurrence of left renal and vesical calculi in an eight-month-old white girl is described. The presenting symptoms were fever, diarrhea, nausea, and vomiting. Investigation of a persistent pyuria revealed bladder and left renal calculi. A progressive left pyelonephrosis developed and left nephrectomy was performed, followed by complete recovery.

The authors emphasize the importance of evaluation of the urinary tracts in children with unexplained fever associated with gastrointestinal symptoms with or without pyuria.

Two roentgenograms; 1 photograph.
H. G. PETERSON, JR., M.D.
New Britain, Conn.

Bilateral Polyadenomatous Kidneys: Adenomatosis of the Kidneys Simulating Polycystic Disease. Herman J. Meisel. J. Urol. **72**: 1140–1145, December 1954.

The author presents the case of a 30-year-old white male whose chief complaint was painless gross hematuria for twenty-four hours. The only positive finding on physical examination was bilateral flank masses, thought to represent polycystic kidneys. At cystoscopy blood was seen to be coming from the left ureter. The bleeding was believed to be due to an erosion or rupture of a cyst into the left renal pelvis. A retrograde

pyelogram was interpreted as confirming the impression of polycystic kidneys.

Because of continued hematuria, surgical exploration was performed and the left kidney was removed. It weighed 800 gm. and was studded with multiple nodules. On microscopic examination these proved to be renal adenomas.

The author believes that Albarran's theory that the precursors of renal adenomas are "islands of imperfectly developed or displaced tubules originating in some aberration of fusion of the nephrogenic and wolffian elements" best explains this case.

Histologically, adenomas are classified as tubular, alveolar, and papillary. All three types were observed in the author's patient.

A search of the literature revealed only one other case in which pyelographic findings indicative of polycystic kidneys were found to be due to diffuse involvement by tumor, namely, lymphoblastoma (Fisher: Grace Hosp. Bull., Detroit **26:** 11, 1948).

One roentgenogram; 1 photomicrograph; 2 photographs. HENRY J. FOX, M.D.
University of Pennsylvania

Hypercalcuria and Metabolic Bone Disease. Milton L. Rosenberg. California Med. **81:** 382–390, December 1954.

The author discusses the entire problem of metabolic bone disease as it relates to hypercalciuria. Urologically, the end-results of hypercalciuria, from whatever cause, are identical, namely, nephrolithiasis and nephrocalcinosis. However, the differential diagnosis and proper identification of the primary lesion in each case will lead to appropriate treatment and improvement. Measurement of calcium excretion while the patient follows a controlled diet is an important step.

A detailed discussion of the clinical states which may present hypercalciuria is presented, including those which are due to increased absorption from the gastrointestinal tract, increased bone resorption, renal acidosis metabolic malignant bone disease, Paget's disease, and sarcoidosis. A discussion of the problems of osteomalacia and osteoporosis is also included.

Six roentgenograms. THEODORE E. KEATS, M.D.
University of California, S. F.

Cicatricial Stenosis of Vesical Neck as a Complication of Retropubic Prostatectomy. Luis F. Ajamil and Mariano Valverde. J. Urol. **72:** 1201–1204, December 1954.

The authors report on the diagnosis and treatment of cicatricial stenosis of the vesical neck, which appears to be a late complication of suprapubic prostatectomy. The mechanism by which this process occurs is unknown. It consists of a fibrous septum at the vesical neck which will not allow passage of instruments into the bladder.

X-ray examination will exclude a calculus or foreign body. The injection of an opaque substance permits visualization of the prostatic portion of the urethra and generally a dilatation can be seen which is interpreted as the remains of the prostate. By exertion of adequate pressure during injection of the medium, the obstruction can be overcome, and a filiform opening between the urethra and the bladder is demonstrated. Complete filling shows the stenosing septum.

Therapy with bougies and sounds is ineffective and usually results in increase in the narrowing. Incision by means of a cutting electrode, through a panendoscope, and removal of the septum by a resectoscope is the procedure of choice.

Three roentgenograms; 3 drawings.
HAROLD L. ATKINS, M.D.
University of Pennsylvania

THE SPLEEN

Malign Tumour of the Spleen Diagnosed by Lienal Arteriography. Gunnar Edsman. Acta radiol. **42:** 461–464, December 1954.

Primary tumors of the spleen are extremely rare and are seldom diagnosed clinically. The author presents a case of malignant splenic neoplasm, probably endothelioma, diagnosed by splenic arteriography, with the demonstration of the free occurrence of pathologic vessels in the enlarged spleen. He suggests that splenic arteriography may be justified in equivocal types of splenomegaly.

Four roentgenograms. GEORGE BACKER, M.D.
Indiana University

TECHNIC

A Technique for Roentgenographic Examination of Newborn, Premature, or Ill Infants Without Removal from an Incubator. Henry K. Silver and William L. Nyhan. Pediatrics **14:** 666–667, December 1954.

A device is described which permits adequate roentgen examination of the newborn infants without cessation of oxygen therapy or alteration of environmental temperature or humidity. It consists of a radiolucent plastic platform which can be placed in the bottom of an incubator. The infant lies on the platform and a cassette can be slid under it. A portable oxygen tank is also affixed to the incubator carriage.

Two photographs. H. G. PETERSON, JR., M.D.
New Britain, Conn.

On Microtomography. Knut Lindblom. Acta radiol. **42:** 465–468, December 1954.

The author describes an apparatus for radiography of histologic detail, utilizing micro-target x-ray tubes, magnification technic, and tomography. With fine-grain intensifying screens against the film emulsion, the image definition is good enough to allow roentgenograms to be enlarged ×2. By means of a target size of 0.1 mm., the direct magnification can be carried to 5 times the original, thus giving a total magnification of ×10.

Tomography is necessary to avoid interfering structures in the microscopic slides. The conventional technic, however, does not afford sufficient definition, because of the long exposure and relatively great angles of movement. By using rotational tomography at small angles, these drawbacks are overcome, with negligible amounts of distortion.

An anatomic specimen of tubal pregnancy with contrast-filled vessels was studied by this method and arteries of 0.1 mm. diameter as well as venous sinuses were well visualized.

Six roentgenograms; 1 photograph; 1 drawing.
JOHN A. CAMPBELL, M.D.
Indiana University

RADIOTHERAPY

Treatment Planning in Roentgen Therapy. Robert J. Bloor and Raymond S. Quick. Am. J. Roentgenol. **72:** 961-973, December 1954.

Three general methods for determining tumor dosage and demonstrating tumor radiation distribution within the patient have been used:

1. Estimation from tables or curves of the central axis depth dose.
2. Point-by-point summation, using isodose curves.
3. Direct isodose summation.

The central axis estimation method is the simplest but provides no information about the homogeneity of the dosage throughout the tumor area, nor about the adequacy of coverage of the tumor volume by the beams of radiation. The therapist is not enlightened concerning dose distribution away from the point of beam intersection, and the location and intensity of high dose areas are not indicated. In intensive therapy, where high doses are necessary, approaching tissue and patient tolerance, this may lead to excessive irradiation in some areas and inadequate irradiation in the tumor. In the palliative treatment of lesions which require low total dosage well below tolerance limits and where single ports or simple opposed port arrangements are used, central axis estimation may be adequate.

The point-by-point summation method is too tedious and time-consuming for routine use. It requires the following 5 steps: (1) preparation of a patient cross-section outline; (2) construction of a regular grid of points at 1 to 2 cm. intervals throughout the treated area; (3) tabulation and summation of the contribution of each port to each point; (4) entry of the summated figures on the patient outline grid; (5) drawing of composite curves by inspection from the grid.

Direct isodose summation is a much simpler and more rapid procedure for the preparation of complete isodose plots. It is carried out by superimposing and combining isodose curves in pairs until all the desired fields have been included. The extent of maximum dose is clearly shown, regions of excessive dose are demonstrated, and the completeness of tumor coverage is easily seen. The information is given in graphic form and can be comprehended at a glance. This method, therefore, must be considered the optimum presentation of dosage information.

Eleven figures. A. J. NICHOLAS, M.D.
Shreveport, La.

X-Ray Dosage Distribution in Limited Media. L. G. Stephens-Newsham and J. A. R. Cloutier. J. Canad. A. Radiologists **5:** 54–56, December 1954.

All published tables of central axis depth dose data have been prepared from measurements made on phantoms sufficiently large to avoid any effects due to boundaries. Since, however, anatomical forms are limited in size, the authors have investigated the effect on the dose of limiting the size of the phantom. They used cylindrical water phantoms with diameters of 8, 12, 15, and 20 cm. The x-ray beam was collimated by three different cones, 5 × 5 cm., 6 × 8 cm., and 10 × 10 cm., to study any possible influence due to boundaries of the irradiated object. Deviation of depth doses and exit doses were most noticeable when phantom dimensions were less than those of the beam.

The tables reproduced here illustrate the deviation.

Field Size	Per cent Error in Exit Dose			
	8 cm.	12 cm.	15 cm.	20 cm.
5 × 5 cm.	− 2	−3	0	0
8 × 6 cm.	−10	−3	−2	0
10 × 10 cm.	−14	−8	−4	−3

Field Size	Per cent Error in Mid-Point Dose			
	8 cm.	12 cm.	15 cm.	20 cm.
5 × 5 cm.	0	0	0	0
8 × 6 cm.	−8	−1	0	0
10 × 10 cm.	−9	−2	−2	0

Two illustrations. GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Irradiation of Skin Tumours During Pure Oxygen Inhalation. K. A. Hultborn and A. Forssberg. Acta radiol. **42:** 475–484, December 1954.

One of the effects of ionizing radiation is the production of very short-lived, strongly oxidizing radicals produced by irradiation of the water in the cell. The presence of oxygen increases the production of these deleterious radicals.

The principle that increased oxygen tension during irradiation runs parallel with increased damage is universal. The per cent increase in biologic effect will be high when the oxygen supply is varied between zero concentration and a concentration similar to that in the normal healthy cells. An increase of the oxygen supply above that of the average value for normal cells does not cause much additional damage. Tumors are generally characterized by an anaerobic metabolism concomitant with a low oxygen concentration of the tumor cells.

The authors concluded from the above considerations that, if the oxygen concentration of the tumor cell could be experimentally increased, then the irradiation effect on the tumor cell would be enhanced while that of the normal cell would be essentially the same.

Four cases are presented in which a comparison was made of the effect on the tumor and the surrounding normal skin of irradiation with and without inhalation of pure oxygen. Skin carcinomas were treated. The large tumors were divided into two treatment areas of equal size. One half was treated in the morning without oxygen, the untreated area being covered with a lead shield. In the afternoons, the other area was treated with the same dose, but with the patient inhaling oxygen. When several small tumors were present, some were treated while the patient was inhaling oxygen and the others without the oxygen.

In these 4 cases inhalation of oxygen amplified the effect of irradiation, especially in the tumor.

Seven figures; 4 tables.

HOWARD C. NEUCKS, M.D.
Indiana University

The Rationale and Results of Simple Mastectomy Plus Radiotherapy in Primary Cancer of the Breast. L. H. Garland. Am. J. Roentgenol. **72:** 923–941, December 1954.

Radiologists and surgeons are in the process of re-evaluating the methods for the treatment of breast cancer. In this paper Garland makes valuable and searching comment on the subject based on recent work of others, as well as his own. The reader is urged to study the original article. Only a few of the highlights are included in this abstract.

It would be highly desirable to classify cases of mammary carcinoma as radiosensitive and radioresistant. The radiosensitive group should have a simple mastectomy with radiotherapy to the chest wall and the chain of nodes in the axilla, neck, clavicular region, and the internal mammary area. The radioresistant group should have a radical mastectomy followed by radiotherapy as indicated. In the radioresistant group, the author includes, for obvious reasons, the very obese, the patient with apical tuberculosis, or the unstable individual who may not complete her course of postoperative radiotherapy. In these patients radical surgery is to be preferred. It is contraindicated in most of the questionably operable and in all the frankly inoperable cases, since it may spread the cancer and will actually shorten survival time.

Since radiosensitivity is not determinable preoperatively and since surgical removal is a more certain method of eradicating a localized cancer than irradiation, it is advisable that surgery be used to remove the primary lesion in all apparently operable cases. This permits identification of the tumor, serving as an excisional biopsy with minimum chance of disseminating disease. The five- and ten-year survival rates in properly selected operable cases are essentially the same whether the treatment be radical mastectomy or simple mastectomy with postoperative radiotherapy. The advantages and disadvantages of the latter procedure are set forth and the results obtained by McWhirter (see editorial in Radiology **65:** 111, July 1955), and others are quoted. All records indicate that simple mastectomy and postoperative radiotherapy with a tumor dose of 4,000 r yield about 60 per cent five-year survival for Stages I and II. This is an improvement over radical mastectomy and postoperative radiation, for which the most enthusiastic surgeons claim a 50 per cent five-year survival for these stages.

[No detailed discussion of the possibilities of modern preoperative radiation as an aid in classification of breast cancer radiosensitivity is given. Such a procedure might aid in deciding whether to do a simple or radical mastectomy. If carefully and properly applied, it might prevent the spread of cancer during operation. It is to be hoped that the author will be able to report such a study in the future.—W.S.]

Five figures; 14 tables. WILLIAM SNOW, M.D.
Shreveport, La.

A Study of Radiation Dosimetry in the Treatment of Cervical Cancer. George C. Lewis, Jr., Richard H. Chamberlain, John Hale, and Franklin L. Payne. Am. J. Roentgenol. **72:** 975–983, December 1954.

At the Hospital of the University of Pennsylvania the five-year survival rate of 46 per cent following radiation therapy for cervical carcinoma was accompanied by a serious complication rate of 14 per cent. Search for the faults proved fruitless because of lack of information concerning tissue dosage both to tumor-bearing areas and to contiguous structures. A program was therefore instituted, to calculate depth dosage to both tumor and normal structures and to correlate this information with subsequent tumor destruction and normal tissue response in each patient. For this purpose orthographic pelvimetry, as described by Hodges and Nichols (Radiology **53:** 238, 1949), was used.

A series of roentgenograms are made by the orthographic technic. Barium in the rectum, opaque medium in the bladder, catheters in the ureters, and a metal clip on the cervix visualize these structures on the roentgenograms made after the radium is applied. Reconstruction of the spatial relationship of objects in the pelvis permits the calculation of the accuracy of this technic in phantoms. It has been found that a maximum error of about 3 per cent is introduced into the final dosage calculations.

The ultimate results as to survival and complications must await long-term follow-up study.

Three diagrams; 3 photographs.

A. J. NICHOLAS, M.D.
Shreveport, La.

Radiosensitivity Testing of Cervical Cancer. A Preliminary Report. S. B. Gusberg, H. M. M. Tovell, Roger Emerson, and Hannah Allina. Am. J. Obst & Gynec. **68:** 1464–1471, December 1954.

The authors, using acetocarmine stains of smears prepared from tissue-crush preparations of cervical biopsies, have noted two types of tumor cells similar to those reported by Caspersson (Acta radiol. Supp. 46, 1942. Reviewed in Radiology **46:** 606, 1946) and also some Italian workers. Those of one type (A) are active, aggressive cells with nuclei rich in desoxyribonucleic acid (DNA), showing clumping of chromatin material and well demarcated nuclear borders. Those of type B are regressive, with nuclei poor in DNA, but nucleoli rich in ribonucleic acid, and with poorly defined nuclear borders, diffuse chromatin, and prominent nucleoli. These two main types of cells and intermediate or transitional cells have been detected and counted from multiple cervical biopsies taken before and during radiation treatment.

Several tumors with their active growing zone rich in A type cells have shown a reversal of A/B cell ratio during the period of clinical healing under radiation therapy. Studies so far suggest that the activity of tumor cells may be used as a guide to radiosensitivity of a cervical tumor and that these changes may occur before clinical regression is evident, perhaps in the first two weeks after treatment is begun. No definite conclusions have as yet been reached. Technic of preparation and counting of smears are described.

Two photomicrographs; 4 figures.

W. A. NAFIS, M.D.
Jefferson Hospital

Management of Malignant Disease in the Neighborhood of the Hip. Bradley L. Coley and Norman L. Higinbotham. Surg., Gynec. & Obst. **99:** 727–732, December 1954.

Malignant disease located in the region of the hip calls for various methods of treatment, depending upon its exact location, histologic type, radiosensitivity, and operability, as well as the age and general condition of the patient.

With steady improvement in operative mortality rates and progressive improvement in the manufacture of prostheses, hemipelvectomy has increased in popularity, while hip joint disarticulation is less often employed. Hemipelvectomy is especially indicated in low-grade so-called secondary chondrosarcoma (chondrosarcoma arising on a pre-existing central chondroma or osteochondroma) of the innominate bone or proximal femur, without evidence of metastasis, where it offers either long-term palliation or a permanent cure. Operative results are presented. The authors strongly urge that, in the face of a possible hemipelvectomy, preoperative irradiation be avoided, as it makes the subsequent operation more difficult and increases complications.

In diagnosis, a careful history and physical examination are essential, with special attention to a history of pain, swelling, and disability. Adequate roentgen examination of both bone and soft tissue is very important. Before operation a microscopic study of biopsy material is essential. The clinical and roentgenologic findings are considered more valuable than the microscopic report when sarcoma is suggested by the former and chondroma by the latter.

The authors prefer roentgen therapy for Ewing's sarcoma (endothelioma) and reticulum-cell sarcoma, since they are relatively radiosensitive. Tumor doses in the range of 4,000 r for Ewing's sarcoma and 3,600 r for reticulum-cell sarcoma are used. For plasma-cell myeloma both roentgen therapy and urethane are employed.

Metastatic cancer is the most common variety of malignant disease occurring in the hip region. Roentgen treatment may relieve pain and prolong life.

Five roentgenograms; 2 photographs.

JAMES A. LYON, JR., M.D.
University of Pennsylvania

Irradiation Therapy in Urology. George W. Blomfield. Brit. J. Urol. **26**: 301–316, December 1954.

This, the first of a series of papers presented at the 1954 meeting of the British Association of Urological Surgeons, recounts the authors experiences and opinions with respect to radiotherapy in urology. It is based on experience in the Sheffield National Center for Radiotherapy.

In cases of Wilms' tumor, if tumors were massive, preoperative deep x-ray therapy was given and usually brought about useful regression. Nothing more than palliation was obtained from radiotherapy for metastases.

In renal carcinoma, the author regards surgery as the treatment of choice. Postoperative irradiation is given when at surgery the tumor is found to extend beyond the capsule or to involve the renal veins. Since 1950, supervoltage therapy apparatus has permitted postoperative dosage to be carried up to about 5,000 r to the tumor bed in four weeks. This appears to have improved results considerably. Out of 9 patients so treated postoperatively between 1950 and 1952, 7 remained alive.

For ureteral carcinoma radiotherapy is used only in cases of recurrence, and in none did the patient live more than three months.

With respect to carcinoma of the bladder, the author quotes more from the literature than from his own experience. Radon seed implants have been used for small areas in which the growth is not deeply infiltrating. Radioactive tantalum wire implants have the added advantage of being removable per urethra. Radiobromine intracavitary treatment, with a catheter bag which adapts itself to the shape of the bladder, has been suitable for multiple papillomatosis if not too massive or deeply infiltrating. Radiocobalt, when used as a central radiation source by means of special bag and catheter, has given equivalent results. Supervoltage x-ray therapy has controlled many cases of advanced bladder carcinoma, and seems indicated in extensive tumors which are beyond the range of radon implants.

For carcinoma of the seminal vesicles or of the urethra, treatments have been possible with radium or with deep x-ray irradiation. The latter probably has the most to offer in extensive growths.

Carcinomas of the penis usually have done well under x-ray therapy. Deep roentgen irradiation has also been given for secondary deposits, which constitute the principal danger in these cases.

Twelve figures, including 2 roentgenograms; 5 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Irradiation Therapy in Urology: The Kidney. E. W. Riches. Brit. J. Urol. **26**: 319–323, December 1954.

This report comes from the Middlesex Hospital, London. One hundred and thirty-one cases of renal adenocarcinoma treated by surgery plus postoperative roentgen irradiation showed a 6 per cent increase in survivals at one year, 9 per cent at three years, 19 per cent at five years, and 10 per cent at ten years, over cases treated by nephrectomy alone. Cases with venous involvement or spread of the growth through the kidney capsule and those showing a high grade of malignancy histologically are thought to be especially in need of postoperative x-ray treatment.

Preoperative therapy is not frequently regarded as useful. On occasion, however, it may reduce a large tumor to more manageable proportions. It is indicated in the presence of fixation and in otherwise inoperable cases.

Tumors of the renal pelvis are irradiated postoperatively if there has been any spill of urine or tumor during the operation.

Wilms' tumors, when so large as to be inoperable, may be reduced by x-ray therapy to operable size. However, because of the debilitating effects of the treatment, such therapy is limited to exceptional cases. Postoperative therapy is generally advised.

Although no renal tumor has been proved cured by irradiation, the author makes it a general rule that radiotherapy follow all nephrectomies for renal adenocarcinoma or Wilms' tumor. For preoperative therapy, a dose of 3,000 r in three weeks is advised. Nephrectomy should follow within ten days. For postoperative treatment 5,000 to 6,000 r is suggested.

Seven roentgenograms; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Treatment of Malignant Tumours of the Bladder by Irradiation Therapy. D. S. Poole-Wilson. Brit. J. Urol. **26**: 326–342, December 1954.

Over a period of three and a half years 313 bladder tumors were treated by the author at the Christie Hospital and Holt Radium Institute, Manchester. Ninety-

two per cent were carcinoma or severe generalized papillomatosis.

Irradiation was given in selected cases as follows: (1) implantation of the base of tumor with radon seeds after open-diathermy excision when growth was localized and not too deeply invading; (2) deep x-ray therapy when the tumor was unsuitable for implantation due to multiplicity or extensive invasion; (3) deep x-ray or intracavitary radiation in cases of low growing papillomatosis or diffuse superficial invasive tumors.

The results following radon seed implantations indicate that such treatment is successful in about 50 per cent of cases if the tumor has not penetrated the bladder wall.

Following deep x-ray therapy, five-year survivals were obtained in 25 per cent of 66 patients. Intracavitary irradiation in diffuse papillomatosis failed in 5 of 6 cases to eradicate the papillomata. However, in diffuse or multiple carcinomata such treatment had kept 50 per cent of patients alive three years, and half of these free from tumor.

The author has included in this article a brief history of radon implantations, along with a review of the technic and limitations of the procedure.

Eleven figures, including 3 roentgenograms; 8 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Irradiation Therapy for Prostatic Cancer. J. D. Fergusson. Brit. J. Urol. **26**: 347–349, December 1954.

Prior to the advent of hormonal therapy in cancer of the prostate, irradiation was often used to palliate the disease. This prolonged the survival period in many cases but the low-voltage apparatus used led to generally indifferent results.

High-voltage irradiation, alone or combined with stilbesterol, might logically be expected to achieve results comparable to those obtained in other types of cancer. However, surrounding structures become irritated with this treatment, and more often than not metastases develop.

Injection of colloidal radiogold directly into the prostate is limited to cases without metastases, and in Great Britain, as yet, has given only equivocal results.

It appears that the future of radiotherapy in prostatic cancer depends upon discovery of a radioactive substance for which tumor cells are specifically selective. At present it is necessary to depend upon local injections into the primary tumor, and to hope for a limited transference of the radioactive material along the adjacent routes of dissemination.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Radiotherapy in Malignant Disease of the Testicle and Penis. Robert Cox. Brit. J. Urol. **26**: 350–361, December 1954.

In the Westminster Hospital, London, from which this report comes, testicular tumors are treated by a combination of orchiectomy and prophylactic irradiation to the lymphatic drainage area immediately following operation. Treatment ports include the lower and upper para-aortic as well as the inguinal node areas. Ports which are too wide may cause rather extensive renal damage. The author also treats metastases beyond the abdominal area with irradiation, except in cases of multiple pulmonary deposits.

Of 32 patients with seminoma 65 per cent survived more than ten years. Three of 12 patients with teratoma (25 per cent) survived for a like period. With higher-voltage apparatus and larger tumor doses, improvement of results is to be expected.

In cancer of the penis, radiotherapy is limited to cases which do not involve the meatus, urethra, corpora cavernosa, or body of the spongiosum. Interstitial radium needle application is favored over other forms of radiotherapy by the author, and with it he gives 6,000 r to the lesion and its immediate surroundings in six or seven days. Prophylactic inguinal node irradiation is condemned. If nodes are involved, block dissection is performed. If they are inoperable, radiotherapy is advised.

In a series of 67 cases, results were inconclusive and of doubtful significance. The best results are apparently obtained by a wise selection and combination of methods.

Six figures; 5 tables. DON. E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Ill-Effects of Radiotherapy. D. M. Wallace. Brit. J. Urol. **26**: 364–368, December 1954.

In this paper the ill effects which might be encountered with various types of irradiation about the urinary tract are enumerated.

From external irradiation possible early effects are skin reaction, diarrhea, bladder irritability and ureteral obstruction from trigonal reaction. Later, replacement of muscular tissue by fibrosis, necrotizing arteriolitis, hemorrhage, or bladder wall necrosis may be seen.

Interstitial irradiation of bladder tumors may be complicated by later painful necrosis, requiring total cystectomy, or failure to control the tumor due to faulty implant distribution.

Intracavitary irradiation, if too intensive and given over too short a period, has resulted in small, contracted, fibrotic bladders. Other complications due to blood-vessel changes in the muscle and submucosa are seen occasionally. These include mucosal atrophy, severe hemorrhage from telangiectases, and development of new tumors.

Once irradiation has been given, treatment with diathermy or conservative surgery is often unsafe. Thus, wherever conservative treatment can be carried out satisfactorily, it is probably unwise to use irradiation.

Four photomicrographs.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Hodgkin's Disease. Ralston Paterson and Edith Paterson. Brit. M. J. **2**: 1315–1318, Dec. 4, 1954.

The death rate in England from Hodgkin's disease is approximately one-hundredth of that for cancer as a whole. Two men are affected for every woman, and the incidence is greatest in middle adult life, at the time of greatest working capacity. Since the disease is always fatal, treatment is directed to the relief of symptoms. Surgery is required for biopsy and may be used where masses are localized as one method for their removal. Radiotherapy, however, is the mainstay of treatment. Resolution of the affected lymph node groups is obtained, with relief from pressure and un-

sightly masses. The intolerable itching due to retroperitoneal node involvement is also relieved. Some improvement of systemic symptoms can be expected. As long an interval as possible is permitted between courses of treatment to new foci or recurrent masses. As general deterioration sets in, irradiation becomes increasingly ineffective.

Nitrogen mustard will effect a satisfactory remission in many cases, though the immediate side-effects—vomiting and diarrhea—are distressing. Leukopenia may occur in about two weeks. Benefits become apparent in a day or two—relief of hyperthermia, improved appetite, and a sense of well-being. Enlarged nodes diminish and the itching is helped. Two or three months of relief can be regarded as a good response. The effects of triethylene melamine (T.E.M.) are good, with less side-reaction. Improvement is less rapid but equally maintained. Repeat courses of either of these chemotherapeutic agents are possible at intervals if leukopenia is controlled and provided the bone marrow is not aplastic. The intervals should be six to eight weeks.

Resolution of masses achieved with chemotherapy is of shorter duration than such resolution obtained by local x-ray treatment. Hence, chemotherapy should be kept in reserve for application when response to radiotherapy has dropped. Simultaneous use of chemotherapy and radiotherapy has not proved justifiable.

While Hodgkin's disease is incurable, prolongation of life is possible. Five-year survivals can be obtained in a significant fraction of cases. In the chronic type of case, the patient may be kept in reasonable health up to ten years, in condition to attend to his life work.

Two charts.

DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

Observations on the Diagnosis, Treatment, and Course of Gastric Ulcer. Evaluation of Gastric Irradiation as an Adjunct in Medical Treatment. Erwin Levin, Walter L. Palmer, and Joseph B. Kirsner. J.A.M.A. **156:** 1383–1389, Dec. 11, 1954.

An analysis was made of the diagnostic error, the course, and the results of therapy in 121 patients with benign gastric ulcer who received irradiation in addition to conventional treatment. The observations were made during the period 1937 to 1954. The diagnosis of benign ulcer proved incorrect in 5 patients, an error of 4.1 per cent. Of the remaining 116 patients, 93 were males and 23 females. Only one patient was less than twenty years old; the oldest was seventy. Hydrochloric acid was present in the stomach of every patient.

Roentgen irradiation to the fundus and body of the stomach was administered for the purpose of decreasing, partially or completely, the acid gastric juice; the total depth dose varied from 1,100 to 2,930 r. The irradiation was used as an adjunct to conventional ulcer therapy. In 41 patients achlorhydria developed, lasting for three weeks to thirteen years. In 40 patients the ulcer healed completely during anacidity. Gastric ulcers never recurred during this period. Recurrences also were infrequent in patients experiencing a reduction in gastric acidity of at least 50 per cent of control values.

After medical treatment, including gastric irradiation, the incidence of such complications as hemorrhage, acute perforation, and obstruction was decreased from a pre-treatment rate of 43 per cent to 13.6 per cent. In patients with recurrent ulcers, the interval between recurrences was longer in comparison with the previous pattern.

There were no complications attributable to irradiation during the period of observation, extending for as long as seventeen years. No permanent digestive disturbances developed. The side-effects during irradiation were negligible.

The authors reach the following conclusions. "The correct diagnosis of benign gastric ulcer is possible in 95 per cent of cases when all diagnostic methods are used. The incidence of gastric neoplasm in patients with chronic recurrent benign gastric ulcer does not exceed the frequency of gastric neoplasm in the general population. . . . Moderate roentgen irradiation of the fundus and body of the stomach, for the purpose of decreasing completely or partially the secretion of hydrochloric acid, is a safe and valuable adjunct to conventional medical treatment of benign gastric ulcer. The results of gastric irradiation are correlated directly with the degree of reduction in acid output and with the duration of the inhibitory effect. The complete and sustained elimination of hydrochloric acid from the gastric content results in complete and permanent healing of benign gastric ulcer."

Twelve tables.

JOHN P. FOTOPOULOS, M.D.
University of Michigan

The Management of Keloid in the South African Bantu. J. C. Allan and P. Keen. South African M. J. **28:** 1034–1037, Dec. 4, 1954.

The authors make a distinction between keloid and hypertrophic scar. Keloid they define as a fibrous overgrowth in the skin resulting from trauma and irritation in a susceptible individual; hypertrophic scar as a raised fibrous ridge in the course of an incision which has injured the whole thickness of the skin. Keloid is common in the South African Bantu, and the incidence of recurrence after "adequate" excision is extremely high. An outline of treatment is presented to meet the special requirements of the Bantu, which necessitate certain deviations from the accepted method of treatment in Europeans. For socioeconomic reasons, treatment must be completed in about three weeks, and the dosage is higher than that recommended for the European.

Under existing circumstances, the most adequate treatment is the combination of excision and irradiation. The total irradiation dosage is about 2,000 r, either 800 r preoperatively and 1,200 r postoperatively or the total amount postoperatively, beginning on the tenth day after the operation.

In cases requiring skin grafting after excision of the keloid, the donor areas should receive prophylactic irradiation.

RADIOISOTOPES

Renal Function and I^{131} Clearance in Hyperthyroidism and Myxedema. Charles J. Hlad, Jr., and Neal S. Bricker. J. Endocrinol. & Metab. **14**: 1539–1550, December 1954.

Renal function studies including glomerular filtration rate and renal plasma flow were performed on 4 patients with hyperthyroidism, 5 with primary myxedema, and 2 with panhypopituitarism. The occurrence of increased values in hyperthyroidism and depressed values with hypofunction indicated a definite influence of thyroid activity on renal hemodynamics. This correlation between metabolic state and renal function appeared better defined in the myxedematous group, with depression somewhat greater and more consistent than the elevation in the hyperthyroid group. In all groups there was a tendency for clearance values to revert toward normal following treatment.

The clearance of I^{131} in hyperthyroidism and in myxedema, as well as in euthyroidism, has been found to be a linear function of the glomerular filtration rate. Thus, I^{131} clearance is increased in hyperthyroidism and is decreased in myxedema. Studies with triiodothyronine and thyroid-stimulating hormone were performed, but no definite evidence was obtained of an active transport mechanism for iodine. The authors provisionally conclude that the state of thyroid activity influences the renal excretion of iodine indirectly through the filtration-rate effect, but that there is no apparent specific influence of thyroid or thyrotropic hormone at the tubular level.

Two graphs; 6 tables. C. M. GREENWALD, M.D.
Cleveland Clinic

The Diagnostic Use of I^{132}. E. M. Hanbury, Jr., J. Heslin, L. G. Stang, Jr., W. D. Tucker, and J. E. Rall. J. Endocrinol. & Metab. **14**: 1530–1538, December 1954.

The application of I^{132}, with a half-life of 2.33 hours, to previously designed tracer technics is presented. This short-lived isotope is eminently suitable for certain studies and recently a method was devised whereby it can be separated from tellurium^{132}. This latter isotope decays with a half-life of seventy-seven hours into I^{132} (Stang *et al.*: Nucleonics **12**: 22, August, 1954. Abst. in Radiology **64**: 909, 1955). The effective half-life of the *available* I^{132} then becomes seventy-seven hours, solving an otherwise almost insurmountable problem in distribution.

Clinical data on 11 patients includes one-hour thyroid uptake determinations and 30-minute thyroid clearance rates. The considerable variation in uptake at one hour was somewhat unexpected. In one patient studied with 5 tracer doses, the maximum variation was 26 per cent of the mean. In general, uptake and clearance values fell within the range previously described for I^{131}.

The beta and gamma ray energies are greater for I^{132} than for I^{131}. However, in spite of the greater energy, the very short half-life reduces I^{132} radiation to the thyroid and the general body to about one thirtieth of that of I^{131}. This decreased dose is advantageous for tracer experiments, where minimal radiation is desired. Studies on normal subjects and on children become less hazardous. Where repeated studies are desired, these can be easily made every twenty-four hours without the problem of correction for undecayed isotope within the subject.

Four graphs; 3 tables. C. M. GREENWALD, M.D.
Cleveland Clinic

Carcinoma of the Cervix: Results Obtained from the Irradiation of the Parametrium with Radioactive Colloidal Gold. Willard M. Allen, Alfred I. Sherman, and A. Norman Arneson. Am. J. Obst. & Gynec. **68**: 1433–1443, December 1954.

During the four-year period 1950–53, the authors treated 324 patients with cancer of the cervix, Stages I, II, and III, using two different methods. One group, which has been subdivided into clinic and private patients, was treated with x-rays and radium. In the second group the parametrium was treated with radiogold injected transvaginally and the cervix was treated either by radium or by Wertheim hysterectomy, or both. In all patients operated upon, a fairly extensive pelvic lymphadenectomy was done at the time of hysterectomy.

The two- and four-and-a-half-year survival rate for patients with Stage I lesions was 91.4 per cent in the series treated with radiogold, 78.1 per cent for private patients treated with x-rays and radium, and 72 per cent for clinic patients treated with x-rays and radium. For one-half to four and a half years the corresponding figures were 92.1, 80.4 and 68.8 per cent, respectively. One-half to four-and-a-half-year survivals for Stage II lesions were 89.3, 56.5 and 48.1 per cent, respectively, but not many Stage II lesions were treated with radiogold in the first two years of the study.

Lymph nodes were positive in 11 out of 70 patients subjected to radical operation; 9 of these patients were alive and apparently free of disease at the time of the report. The incidence of positive nodes in the operated cases was 9.8 per cent for Stage I and 31.5 per cent for Stage II. In 3 patients fistulas developed; all were in the group treated by radiogold and radium followed by operation.

The authors feel that a dosage of 8,000 to 10,000 r is necessary to destroy epidermoid cancer of the cervix itself.

This paper must be considered a preliminary report because of the short-term follow-up and patient selection, as pointed out by the authors, but it suggests an interesting aspect of treatment of carcinoma of the cervix.

One graph; 7 tables. ROBERT L. EGAN, M.D.
Jefferson Hospital

Time and Site Study for Optimum Lymph Node Concentration of Radiogold Following Intrabronchial Injection. Harold F. Berg, William M. Christopherson, and J. Ray Bryant. Cancer Res. **14**: 775–779, December 1954.

Colloidal Au^{198} was injected into the bronchial mucosa of dogs in an attempt to determine the rapidity of concentration within the regional lymph nodes and the site of injection for optimal concentration within the nodes. Specimens of the nodes and viscera were measured for radioactivity. Histologic sections and autoradiographs were examined and compared with

those from a group of animals receiving a similar dosage of Au^{198} and sacrificed in one to five weeks.

Colloidal gold with particle size ranging from 0.003 to 0.004 μ concentrated within the regional lymph nodes well within the effective activity range of the isotope. Radioactivity was concentrated in the nodes and was not distributed in any appreciable amount to other organs.

The most effective site of injection within the bronchial tree was found to be the most dependent accessible site within the bronchus.

Radiation necrosis within the lymph nodes had a patchy distribution when small doses of Au^{198} were used. This distribution was confirmed by autoradiographs.

Two radioautographs; 2 photomicrographs; 3 charts.

Radioactive Phosphorus in Management of Brain Tumors. Richard W. Garrity and LeRoy W. Matthews. Neurology **4:** 929–934, December 1954.

During the period from January 1952 to January 1954, the authors used radioactive phosphorus for investigation of 24 of a series of 66 brain tumors. Their technic was that described by Selverstone and his associates (see, for example, Selverstone, Sweet, and Robinson: Ann. Surg. **130:** 643–650, 1949. Abst. in Radiology **55:** 472, 1950), involving the use of a probe counter. Five cases are presented to show the diagnostic and surgical value of the procedure. In only one instance was the tumor not demonstrated. In this particular patient, a 73-year-old woman with a history of sudden deafness six and nine years previously, the isotope failed to localize small bilateral acoustic neuromas, 1.5 and 2.5 cm. in diameter, blocking the cisterna ambiens and the tentorial ring. In the remaining 23 cases, there was definite verification, localization, and delineation of the tumor. In the 23 tumors localized and delineated by the probe counter, the ratio between the count obtained in the tumor and that obtained in uninvolved brain varied from 6:1 to 75:1. The higher ratios could not be correlated with the degree of malignancy. Cerebellar astrocytomas frequently showed higher ratios than many of the very malignant glioblastomas.

Radioactive phosphorus has been used routinely whenever angiography fails to give fairly definite information with respect to the location and nature of the tumor. The isotope is given at least twelve hours in advance, and for this reason angiography is usually performed on the day preceding contemplated surgery. This allows time for ventriculography the morning following inconclusive angiography and at the same time allows for adequate uptake of P^{32} in the tumor area. No ill effects have been observed in patients receiving the isotope. Scanning of the tumor bed after surgery has also proved to be a valuable procedure. On at least one occasion residual tumor was located and removed.

Two roentgenograms; 2 tables.

Fate of Injected Radiophosphorus-Labeled Leucocytes. William V. C. Leahy, Thomas F. McNickle, and Paul K. Smith. Am. J. Physiol. **179:** 570–576, December 1954.

The investigation described here was undertaken (*a*) to show the initial distribution, in the recipient, of the radioactivity contained in transfused radioactive white blood cells; (*b*) to determine whether or not this initial pattern of activity undergoes change; (*c*) to determine whether or not a change in the site of activity is accompanied by a breakdown of the transfused white blood cells; (*d*) to determine the extent of the changes in the cell components by the identification of the chemical nature of the "gained" or "shifted" activity. All animals used were New Zealand white male rabbits weighing at least 2.5 kg. Radioactive leukocytes for transfusion were obtained from the peritoneum of the rabbit five to seven days after the intravenous injection of P^{32}.

In rabbits killed three to four minutes following the injection of radioactive leukocytes, the greatest amount of radioactivity was found in the lungs (72 per cent). This finding was correlated with the histologic appearance, which showed the alveolar septa crowded with leukocytes. This initial high level of activity in the lungs decreased gradually from three minutes on and was accompanied by a rising level of activity in the liver until, five hours following transfusion, the level of activity in the liver exceeded that of the lungs.

White blood cells used for transfusion studies, the lungs, liver, and spleen, were fractionated into the phospholipid, nucleoprotein, acid-soluble inorganic, and acid-soluble organic fractions. The results of these analyses showed that, following pulmonary sequestration, there was an immediate cellular breakdown. A comparison of the activities of the pentose nucleic acid and desoxynucleic acid in the white cells and in the spleen revealed that only the desoxynucleic acid was present in appreciable quantity in the spleen, indicating cellular disintegration.

Differential Radiophosphorus Uptake of Lens. William H. Havener and Charles T. Knorpp. Arch. Ophth. **52:** 831–832, December 1954.

With the aid of radioactive phosphorus, given intravenously in the form of acid phosphate, rabbit lenses were examined for evidence of a postero-anterior nutrient flow. The lens epithelium was found to absorb the radiophosphorus to a concentration 100 times that of the rest of the lens. No significant difference was demonstrable in the concentrations of P^{32} in the anterior and posterior portions of the lenses. This experiment cannot, therefore, be used to support a theory of postero-anterior nutrient flow in the lens.

One table.

Low-Level Counting, Key to Advances in Radiocarbon Dating. J. Laurence Kulp. Nucleonics **12:** 19–21, December 1954.

This paper is an account of a conference of leading workers in the field of dating aged materials on the basis of the relative amounts of radiocarbon present. The bearing of recent experimental work on the validity and limitations of such basic assumptions of this method as the constancy of the integrated cosmic ray flux and the rapid mixing of the carbonate reservoir is discussed. Advances in technic have extended the range of this method to 50,000 years. (A particular carbon dioxide proportional counter technic involved in this extension is discussed in a separate article in the January issue of Nucleonics: Radiocarbon Dating System, by G. J. Fergusson, page 18). Some geological results of radiocarbon dating are included.

One illustration; 1 table.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York

Animal Distribution of Colloids of Au^{198}, P^{32}, and Y^{90}: An Improved Method of Tissue Assay for Radioactivity. T. N. Lahr, Robert Olsen, G. I. Gleason, and D. L. Tabern. J. Lab. & Clin. Med. **45**: 66–80, January 1955.

Earlier studies have emphasized the tremendous doses of beta radiation which tissues will tolerate if the material is uniformly distributed in the tissue. In the dosages of Au^{198} employed today, the 10 per cent of gamma roentgens present is almost sufficient to account for the cancerocidal effects observed, and one has, in addition, the biologic effects of the tenfold greater beta radiation. One of the reasons for wishing to develop other colloids involving pure β-emitters is to be able to study independently the clinical value of this beta radiation. A number of such colloids are described by the authors. In evaluating animal results secured with these colloids, it must be kept in mind that in animals gold colloids move from cavities much more rapidly than in human beings. Therefore, colloids showing better retention in animals than gold deserve clinical study if other properties are also favorable.

A quantitative comparison is presented of three types of chromic phosphate colloids, and of several colloids prepared from Au^{198} and Y^{90}. Over 400 animals were used in the investigation. The data indicate excellent cavitary retention in the case of Type G $CrPO_4$, and excellent retention of Y^{90}, as the phosphate.

The authors present a much simplified method for tissue assays, involving homogenization of whole organs, solution of aliquots at room temperature in Formamide, and either beta counting at infinite thickness or, where possible, gamma counting in a suitable well-type scintillation unit.

Four figures; 7 tables.

Incorporation of Radioactive L-Cystine by Normal and Leukemic Leukocytes in Vivo. Austin S. Weisberger and Bennett Levine. Blood **9**: 1082–1094, November 1954.

L-cystine, one of the amino acids, appears to play an important role in the protein metabolism of leukocytes. By tagging L-cystine with radioactive sulfur and giving oral doses to normal and leukemic individuals, *in vivo* studies on leukocytes were performed. (Since the reversible interconversion of cystine and cysteine is readily accomplished, these two compounds are considered as a single amino acid in metabolism.)

Radioactive L-cystine rapidly entered into the protein of white blood cells and of plasma. There were distinct differences, however, in rates and levels of utilization by normal leukocytes and leukocytes of acute and chronic leukemia. The more rapid utilization by the immature leukocytes of leukemia is believed simply to reflect the increased metabolic rate of immature cells in general. However, because of the ability of L-cystine to modify the leukotoxic effect of nitrogen mustard, the differential rates of absorption may later prove to have significance.

This study indicates that normal white cells require about four days to mature and appear in the peripheral circulation, with a subsequent life span of about thirteen days. In chronic myeloid and acute leukemia, leukocytes have a shorter life span than normal. In chronic lymphatic leukemia the life span of lymphocytes is much longer than that of normal leukocytes, sometimes lasting for several months.

One radioautograph; 9 graphs; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Incorporation of Radioactive L-Cystine and L-Methionine by Leukemic Leukocytes in Vitro. Austin S. Weisberger, Leif G. Suhrland, and Robert C. Griggs. Blood **9**: 1095–1104, November 1954.

It having been shown (see preceding Abstract) that radioactive L-cystine and L-methionine are more rapidly incorporated by leukemic leukocytes *in vivo* than by normal leukocytes, *in vitro* studies were undertaken to determine the factors affecting this process.

These studies indicated that incubation time, concentration of the compound, temperature, pH, oxygen tension, electrolytes, and glucose concentration all cause variations in the uptake of these amino acids. Their *in vitro* incorporation is evidently an active process and not solely one of simple diffusion.

The methods presented are suitable for studying possible therapeutic agents as well as biochemical abnormalities of leukocytes and suggest possible avenues by which further studies may be conducted.

Six graphs; 3 tables. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

RADIATION EFFECTS; PROTECTION

Necrosis of the Brain Following Roentgen Irradiation. G. S. Dugger, J. G. Stratford, and Jean Bouchard. Am. J. Roentgenol. **72**: 953–959, December 1954.

Radiation dosage for cancer is being increased more and more. We are learning to accept limited damage to normal tissue provided we destroy the cancer and function of the individual is not seriously impaired. However, radiation damage to the nervous system, particularly the brain, is most objectionable, especially since it may result in mental deterioration. The case report presented in this paper is therefore timely and instructive.

A 54-year-old man was given 4,800 r during a ten-day period to a skin lesion above the left ear, measuring 5 cm. in diameter. The factors were: 150 kv, 0.5 mm. Cu and 0.5 mm. Al filtration, 25 cm. distance. About twenty-six months later evidence of brain deterioration was present, including headache, confusion, forgetfulness, disorientation, drowsiness, and right hemiparesis. The picture was that of brain neoplasm. An operation revealed involvement of the left second temporal convolution. The pathologist reported focal degeneration and necrosis secondary to vascular occlusion from periarteritis and endarteritis. The degeneration was greater in the white matter than in the cortex, probably due to the greater vascular supply.

The authors calculate that the injured brain area, 5 cm. in diameter and 5 cm. deep, received 2,750 r in ten days. On the other hand, they have treated more than 50 pituitary tumors through the same size portal with 5,000 r to the skin and more, during an average of forty-five days, without clinical or operative evidence of brain damage. They therefore point out the importance of protraction when large doses are being delivered to the region of the brain.

The article is concise, to the point, and includes several magnificent photomicrographic illustrations.

Seven photomicrographs. WILLIAM SNOW, M.D.
Shreveport, La.

Pathology of Total Body Irradiation in the Monkey. Hans G. Schlumberger and Jacinto J. Vazquez. Am. J. Path. **30:** 1013–1047, November-December 1954.

To determine the LD 50/30 dose of total-body irradiation for the *Rhesus* monkey, 92 pubertal and prepubertal animals were exposed to doses ranging from 300 to 900 r. To minimize extraneous factors that might affect survival of the animals, the monkeys were handled only at the time of irradiation. Unfortunately, this precluded carrying out any procedures such as weighing, blood counts, and bacterial cultures during life. The LD 50/30 was found to be approximately 550 r, the LD 100/30, 800 r.

A 250-kv Quadrocondex therapy machine was used at 15 ma, with a filter of 0.5 mm. copper and 1.0 mm. aluminum. Each animal, in upright position in a polyethylene cylinder, was irradiated separately while being rotated at 1.3 r.p.m. 1 meter from the x-ray tube. The exposure rate was 23 r/min.

Anorexia developed in all monkeys subjected to 300 to 900 r total-body irradiation within twenty-four hours of exposure. In animals given 300 to 400 r the loss of appetite was transient and unaccompanied by other signs of illness. More intense irradiation (500 to 700 r) was frequently followed by diarrhea which, with doses of 800 or 900 r, was severe. Vomiting was not observed. In animals surviving for two to three weeks (500 to 700 r) the fur became dull and the coat was no longer smooth. After the second week the hair rubbed off against the sides of the cage, leaving large areas of denuded skin. In monkeys that survived there was a regrowth of hair in the bare areas.

The gross and microscopic lesions were strikingly similar to those seen in man. The hematopoietic system was affected first, with destruction of the blood-forming elements in the marrow and loss of lymphocytes from the lymph nodes and spleen. In animals that survived and were sacrificed several months after irradiation there was often a marked follicular hyperplasia in the spleen and lymph nodes.

Hemorrhage occurred most often as petechiae in the skin, lungs, epicardium, stomach, and colon. Epilation was noted about twelve days after irradiation.

Degenerative changes in the germinal epithelium of the ovaries and testes were observed following doses of 500 to 900 r. Atrophy of the adrenal cortex appeared as a late sequel to irradiation.

The colon was the site of hemorrhage and ulceration; however, within a week after irradiation with 800 r, active epithelial proliferation was seen in areas adjacent to ulcerated and necrotic foci.

Necrotic gingivitis and oropharyngitis occurred in 14 monkeys receiving 400 to 700 r and surviving two to three weeks. It closely resembled that observed in human casualties. Beginning in the region of the molar teeth as a shallow hemorrhagic ulceration, it was followed by involvement of the buccal mucosa, accompanied by edema, which occasionally involved the entire face. A noma-like necrosis of the cheeks was an occasional end-result. Large ulcers along the lateral border of the tongue were observed in some cases.

The kidneys, liver, pancreas, central and peripheral nervous systems, muscles, bones, and joints were without changes directly attributable to irradiation.

Thirty-seven illustrations; 2 tables.

Early Radiation Death in Guinea Pigs. K. C. Brace, H. L. Andrews, and E. C. Thompson. Am. J. Physiol. **179:** 386–389, November 1954.

In an effort to clarify some aspects of radiation death, the authors investigated the physiological and hematological changes in a single species at a constant dose rate.

Fifty-six adult male guinea-pigs were exposed to whole-body x-irradiation at graded doses between 1,000 and 25,000 r (the study being limited to this range because of the multiplicity of factors involved in late death), at a constant rate of 50 r/min. Doses between 1,000 and 5,000 r caused death in four to six days and elicited a progressive depression with few other neurologic symptoms. A granulocytosis was present during the first few hours after exposure but subsided prior to death. Doses of 7,500 r or more caused death in less than twenty-four hours and elicited a state of hypersensitivity with convulsive seizures. A marked granulocytosis was present at the time of death. At doses of 6,000 r there were equal numbers of the two types of death. Irradiation of the head alone produced similar effects.

One photomicrograph; 3 charts.

Irradiation of White Mice with Large Doses of X-ray. B. Rajewsky, O. Heuse, and K. Aurand. Strahlentherapie **95:** 513–522, December 1954. (In German)

A special tube for irradiation of laboratory animals with high doses in a short time is described. It features a focal spot of 4 cm. diameter and a water-cooled rotating anode. This tube is suitable for up to 65 kw and is operated at 51 kv. At 8-cm. distance the dose rate is 800,000 r/min.; the h.v.l. is 8 mm. in water. The animals usually are rotated during irradiation.

With 1,200 up to 16,000 r total-body radiation, the survival time of white mice is about 3.5 days. Above 16,000 r, survival is markedly shortened. At about 50,000 r, a new reaction was observed: repeated convulsions occur, which last for one to ten seconds and finally cause death. The latent period of this reaction depends on the dose, being about one day at 50,000 r and one hour at 100,000 r. This effect is due to local brain damage, as could be demonstrated by isolated irradiation of the head.

Ten figures, including 2 roentgenograms.

ULRICH K. HENSCHKE, M.D.
Ohio State University

A Study of the Local Roentgen Reaction on the Skin of Mice, with Special Reference to the Vascular Effects. Finn Devik. Acta radiol. Supplement 119, 1955.

The acute reaction to a single dose of roentgen radiation (usually 2,700 r) was studied in the skin of a strain of hairless mice by observation of the visible reaction, histologic sections, intravascular dye injection, and a modified freeze drying technic, and was found to be mainly dependent on the effect on the epithelial cells. The first appearance of injury is conditioned by the sudden occurrence of great numbers of abnormal mitoses in the epithelial cells. The inflammatory

element of the reaction is caused by the destruction of epithelial and connective-tissue cells. Adjoining non-irradiated cells are able to modify the radiation effects, but the reverse could not be demonstrated. Cell environment both during and after irradiation affects dose response. Regeneration may be due to the existence of a few radioresistant cells which survive.

The vascular factor is of secondary importance in the pathogenesis of the acute skin reaction, which seems to develop independently of the state of the blood vessels. Vascular changes, however, show dependence on radiation effects of the surrounding tissues, being most conspicuous in the vicinity of the markedly affected epithelial cells and least in the radioresistant muscle tissue.

Although the work reported here was done on mice, it is probable, in view of the similar reactions in other mammals, that the observations apply to mammalian tissues in general.

LUCILLE DU SAULT
Henry Ford Hospital, Detroit

Effect of X-Irradiation on Gastric Secretion and the Accompanying Gross and Histological Changes in the "Shay" Rat Stomach. Lawrence E. Detrick, Harvey C. Upham, Dorothy Highby, Virginia Debley, and Thomas J. Haley. Am. J. Physiol. **179:** 462–466, December 1954.

The authors investigated the effect of pre-irradiation on gastric ulceration, the pepsin-HCl activity of gastric juice, and the gross and histologic changes in the stomach of the "Shay" rat over a fifteen-day period following irradiation. [Shay and his associates (Gastroenterology **5:** 43, 1945) found ligation of the pylorus an effective procedure for the uniform production of gastric ulceration in the rat.] One group of animals was untreated, a second group was irradiated only, a third group was subjected to pyloric ligation, and in the fourth both irradiation and pyloric ligation were carried out.

The results obtained confirmed observations previously recorded concerning the production of gastric ulceration by ligating the pylorus. Pre-irradiation of rats subjected to pyloric ligation with 600 r resulted in a great variation in response. Pepsin-HCl activity was or was not decreased. When the former occurred, the usual lytic ulcerative lesions developed in the stomach rumen; the body was only slightly changed, and the antrum was essentially unaffected. When there was a decrease in the pepsin-HCl activity, the resulting lesions were comparable to changes due to irradiation alone. With irradiation alone, the lytic effect on the epithelium of the rumen was less than in the Shay rat, but the accompanying vascular effect was equally severe. In both the irradiated and the irradiated-ligated rats, lesions in the stomach body were characterized by single terminal vascular tufts engorgements that coalesced into focal engorged vascular networks with or without hemorrhagic ulceration. Such lesions were absent in the unirradiated Shay rats.

Hemostasis in Sympathectomized and Adrenalectomized Animals Before and After Total Body X-Irradiation. Alfred L. Copley and Paul L. Stefko. Am. J. Physiol. **179:** 295–300, November 1954.

The authors investigated the role of certain neuroendocrine factors in hemostasis by subjecting animals to sympathectomy, adrenalectomy or both. Their observations were primarily concerned with the effects of these operations on bleeding time and clot resistance.

Three hundred and seventy-six bleeding time determinations were made in 76 rats after adrenalectomy, thoracolumbar sympathectomy, or both. Only three values were markedly prolonged.

Twenty-one bleeding times in 5 sympathectomized and 4 adrenalectomized rabbits were all within the normal range of three minutes.

Eight adrenalectomized and 9 sympathectomized rats and 4 adrenalectomized rats previously sympathectomized were all irradiated with 700 r. Bleeding times were within three minutes on each of the first four to five days after irradiation. One out of 4 animals tested on the seventh post-irradiation day had a markedly prolonged bleeding time. A high incidence of decreased clot resistance was observed in both sympthectomized and adrenalectomized animals.

Direct microscopic observations were made on the capillary beds of the cheek pouches in adrenalectomized or sympathectomized hamsters and of the mesentery in sympathectomized rats, by a double diaphragm method of oblique illumination hitherto not applied to biological materials. The relationship of platelet agglutination thrombi and vasoconstriction in hemostasis is discussed. A new explanation for the narrowing of capillary blood vessels following injury is proposed, *i.e.*, the contraction of an adherent platelet agglutination thrombus.

Five photomicrographs; 1 table.

Combined Effects of Total Body X-Irradiation and Radiant Energy Thermal Burns on the Osmotic and Mechanical Fragility of the Erythrocyte. E. L. Alpen, J. A. Alexander, and A. K. Davis. Am. J. Physiol. **179:** 541–548, December 1954.

A recent report described the effect of various doses of ionizing radiation on both the immediate and long term mortality resulting from thermal burns (Alpen and Sheline: Ann. Surg. **140:** 113, 1954. Abst. in Radiology **64:** 795, 1955). For the purpose of clarifying the mechanisms causing increased mortality from the combined trauma, the osmotic and mechanical fragility of rat erythrocytes was measured during a thirty-day interval following severe and moderately severe burns, 100 and 500 r of whole-body ionizing irradiation, and the two together. Although it is difficult to demonstrate an increased fragility as early as four hours after severe burns, it was found that there is most probably an increased resistance to osmotic hemolysis twenty-four hours later as the result of removal of the most fragile cells. This is a transient phenomenon, normal fragilities being found on the third day. During the recovery period an increased resistance to osmotic hemolysis develops; this may be the result of increased cell turnover.

Irradiation produced an increased osmotic resistance at the 500-r dose level but not at 100 r. This change is correlated with removal of fragile cells and increased red cell turnover.

Combination of the traumas brought about essentially additive results in so far as osmotic fragility is concerned.

Mechanical fragility was found to be increased by lethal doses of ionizing radiation and by lethal combinations of ionizing radiation and burns when neither

trauma was lethal alone. It is thought that the increased mechanical fragility may be a sign of impending death in irradiated animals either in the presence or absence of other complicating trauma.

Eight illustrations.

The Inhibition of Acute X-Ray Damage by Cortisone. L. E. Houghton, J. B. Walter, and D. E. A. Jones. Brit. M. J. **2**: 1313–1315, Dec. 4, 1954.

A dose of 6,000 r was delivered to a circular area of the skin of 38 guinea-pigs. Seventeen days later, 19 of the animals, otherwise untreated, showed large, deep ulcers. Nineteen animals which had received cortisone showed no ulcers. Cortisone acetate was given by subcutaneous injection in 10-mg. dosage twenty-four hours before the first exposure and was repeated each morning throughout the period of observation. No marked toxic effects were noted. Results indicate that administration of cortisone profoundly alters the response of skin to irradiation by x-ray. Epilation is delayed and the early erythema is lessened. The most striking effect is absence of deep ulceration.

It is presumed that the protective action of cortisone against x-ray damage is due to inhibition of inflammation and that the hormone should be effective if given only during the time when such changes are taking place ordinarily. It is not known whether the protective action is a direct effect upon the cells or an indirect effect due to an intermediate. It must be shown that tumor cells are not similarly protected. Also the danger of uncontrolled infection during cortisone therapy must be considered.

DONALD DEF. BAUER, M.D.
Coos Bay, Ore.

The Protective Effect of Cysteamine on Young Mice Exposed to Roentgen Rays. Arne Nelson. Acta radiol. **42**: 485–493, December 1954.

The author discusses the results of tests on the survival of mice exposed to various doses of x-rays, with and without previous intraperitoneal injection of 3 mg. of cysteamine. The results show that there is a higher survival rate following exposure to 800 and 1,000 r, and a longer survival after 1,200 r, in those mice receiving cysteamine, particularly if the injection was made within thirty minutes before exposure. This suggests that cysteamine considerably diminishes the effect of ionizing radiation, at least in mice. However, there were toxic effects in the treated animals, as shown by immediate reaction to injection and inhibition of growth lasting approximately one week.

Fourteen graphs; 2 tables. JOAN HALE, M.D.
Indiana University

Effect of Hydroxylamine and X-Irradiation on Red Cell Destruction and Formation and Serum Iron Concentration. Alfred Chanutin and Elizabeth L. Word. Am. J. Physiol. **179**: 221–224, November 1954.

The authors report an investigation of the effect of hydroxylamine on the serum iron and total hemoglobin concentrations and on the reticulocyte count of blood in the irradiated rat.

Inbred male rats of Wistar stock, sixty to seventy days old, were used as experimental animals. The various compounds employed in the study were freshly prepared in isotonic saline so that the solution contained the desired dose per 100 gm. body weight in 0.25 ml. Each solution was adjusted to about pH 6.0 with dilute NaOH immediately before injection into the jugular vein. The animals received 500 r total-body x-irradiation in a single exposure, about one hour after the injection.

A single intravenous injection of hydroxylamine was found to be effective in producing anemia, hyperferremia, and reticulocytosis in irradiated rats. A number of compounds, including derivatives of phenylhydrazine, hydrazine and hydroxylamine, were ineffective as hemolytic agents.

One chart; 1 table.

Effect of Repeated Injections of Thorotrast on Antibody Production. Lena A. Lewis. Am. J. Physiol. **179**: 285–286, November 1954.

An investigation was undertaken to determine whether permanent blockage of the reticuloendothelial system could be obtained by repeated small injections of Thorotrast.

Twenty-two normal New Zealand white rabbits weighing between 4 and 5 lb. at the beginning of the studies were used. The initial injection of Thorotrast [presumably given intravenously] consisted of 3 ml./kg. body weight; three times a week thereafter the animals received approximately 4 ml. of this agent. Approximately one hour after the administration of Thorotrast these animals, as well as a control group, were given intravenously varying amounts of typhoid vaccine. In all instances the initial dose of vaccine was 10 million organisms; the number of organisms was increased with each succeeding injection. Plasma protein analyses were made on the rabbits before treatment and at monthly or bimonthly intervals thereafter.

The rate of antibody production to the injected typhoid vaccine was found to decrease during the first six weeks of Thorotrast injection. During the following eighteen weeks it rose to normal, despite the presence of large amounts of Thorotrast in the reticuloendothelial system.

Two tables.

Administrative Problems in Radiation Protection. Irving R. Tabershaw and Saul J. Harris. Nucleonics **12**: 8–13, December 1954.

The development of legislation in the radiation protection field is surveyed. Factors which have delayed government regulation in this field, together with the reasons for present legislative plans, are discussed. The extent of activities of various federal agencies, including the Atomic Energy Commission and the National Bureau of Standards, are discussed, together with the status and development of codes by various states. The distinction between detailed specification codes and the more flexible performance codes is outlined, together with desirable provisions in performance codes. Most of the proposed codes emphasize the importance of a qualified expert in radiation physics. A comprehensive list of pertinent documents is appended. A table offers a concise analysis of 46 governmental, industrial, and other regulations.

JOHN S. LAUGHLIN, Ph.D.
Memorial Center, New York